

CHICAGO EXHIBITION, 1893.

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## HAND-BOOK

TO

ACCOMPANY THE COLLECTION OF EXHIBITS  
FURNISHED BY THE FOREST DEPARTMENT  
OF THE GOVERNMENT OF INDIA.



Issued from the Office of the Inspector-General of Forests to the  
Government of India.

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1893.



# H A N D - B O O K

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### PART I.

#### Forest Conservancy in India.

Forestry in India is a comparatively modern institution. In former times, no doubt, considerable areas were scrupulously protected in many parts of the country ; but, wherever this was the case, the forests were kept as game-preserves for the pleasure of princes and great nobles. The idea of conserving forests in order to maintain an uninterrupted supply of forest-produce useful and even necessary for the people,—the idea of maintaining a proportion of the country under forests on account of the indirect benefits conferred on the Empire at large by the very existence of forests,—was never thought of by former governments. Even during the earlier times of British sway, the economic value of forests was not recognised, and they were considered more in the light of impediments than otherwise to the increase of cultivation, and consequently to the general prosperity of the Empire. This period, however, has passed away ; and the necessity for the maintenance and conservative treatment of forests, as a mainstay of agriculture, is now almost universally recognised, while Forest Conservancy is regarded as a duty of the State.

India is not, like Europe, a forest-growing country throughout ; its position in a tropical and sub-tropical climate prevents this, and areas which, with a lesser evaporation, such as takes place in temperate and cold zones, would be clad with dense forest growth, are here arid and may even be

desert. Thanks, however, to the barrier which, in the form of the Himalayas, separates the north of India from the rest of the Asian continent, and in consequence of the pronounced peninsular formation of the Empire, the greater part of the country is suitable for the growth of natural forests. India is a country of extremes, and contains, on the one hand, evergreen forests of a luxuriance and density such as the imagination can hardly picture, and, on the other hand, deserts. The distribution and character of the Indian forests is due, in the first instance, to the more or less plentiful supply of rain, and next to elevation and the influence of the tides. The distribution of the rains in India within distinct periods of time is as marked and accentuated as anywhere in the tropics, and, thanks again to the formation of the country, the monsoons extend far north of the Tropic of Cancer. There are two monsoons, the more important being the summer or south-west. Within the direct influence of the full force of the monsoon rains, the country is covered with evergreen forests. Where the rainfall gets less copious, these change into deciduous forests, gradually blending, with still decreasing rainfall, into dry forests, and ending in unproductive deserts.

The evergreen forests created by the influence of the south-west monsoon occupy the west coast of the peninsula, up to the ridge of the mountain chain separating the moisture-yielding sea from the rest of the continent. In the same way they are spread over the coast districts of Burma and Chittagong, and along the foot and on the lower slopes of the eastern Himalayas. The evergreen forests, due to the winter or north-east monsoon, occupy the Carnatic.

The deciduous forests, which occupy the larger part of the peninsula and Burma and a considerable proportion of the Andamans, are of the greatest importance for the forester, the consumer, and the State. They contain the well known and most valuable species of timber, such as teak, sâl, ironwood, sandalwood, red sandur, and many others : also the padouk (*Pterocarpus indicus*), which is found in considerable quantities and of large dimensions in the Andaman Islands. This

tree has, of all Indian timbers except teak, probably the most promising immediate future. It yields the best wood for ordnance purposes and carriage-building, and is sure to rival mahogany for cabinet-work. The timber is stronger than teak in every direction, lasts longer, is much handsomer, does not warp in seasoning, and only weighs 15 to 20 lb more per cubic foot.

The dry forests are situated in Rajputana and the Punjab, and spread over a large extent of Native States. Towards the north and north-west they become richer and gradually blend into deciduous or alpine forests, whereas they get drier and drier towards the west and south-west, and disappear into the deserts on both sides of the lower Indus, where the courses of perennial rivers alone are fringed by a belt of arbori-vegetation.

Alpine forests are found within the Indian Empire along the whole of the Himalaya mountain chain from Assam to Hazara, in the mountains of south Afghanistan and Baluchistan, and on the higher mountain ranges in Burma.

The tidal forests are situated along the greater part of the coast of India and in the deltas of its rivers.

The foregoing are, shortly summarised, the physical capabilities of India as a forest-growing country. There can be little doubt that in pre-Vedic times the greater part of the Empire was covered with dense forests, which were gradually opened out by Kshatriya settlers along fertile valleys and main streams. At that time, and long after, the country was probably more fruitful and the climate less fierce than now, at least if any trust can be placed in the descriptions of Fa-Hian, the great Chinese traveller who visited India in the fourth century, and who described the climate as neither hot nor cold. The destruction of the forests on a larger scale was left to the invaders from the north—nomadic tribes who had been accustomed to roam from pasture to pasture, and who fired alike hills and plains, and destroyed the forests wherever they went. The sway of these invaders extended over upwards of 750 years; and when, after the battle of Plassey, the foundation of the present Indian Empire was laid, and province after province was conquered, the for es

areas had already, over considerable portions of the country, been reduced below the minimum necessary for its well-being, though other portions of the vast Empire were still covered with almost virgin forest.

British rule, instead of putting an immediate stop to further devastation, gave in the beginning a new impetus to destruction. As already stated, the watchword of the day was to increase the area of cultivation at the cost of the still existing forests, and this policy was carried on for years without any enquiry into the merits of each case. Naturally, incalculable harm was done by such inconsiderate destruction of forests, especially in the more populated districts, where the demand for new land was greatest, and where the forests were often already of less extent than the state of the country demanded. Large areas, though not immediately destroyed, were alienated by settlements and grants, and were thereby withdrawn from further active interference on the part of Government. Security to life and property enabled the peasants and herdsmen to graze their cattle far from their homes and unprotected, and at the same time cattle increased in value. Herds naturally multiplied, and additional grazing areas being required were cleared by fire, thereby opening the way to future famines and distress. Railways soon spread over the country, and forest growth disappeared with an incredible rapidity within the reach of their influence, partly on account of the direct demands made on them for construction works—demands which were frequently supplied in a wasteful and reckless manner—partly on account of the increased impetus given to cultivation.

It was only when failures to meet local demands for public works were brought to notice, that the value of the forests was gradually recognised. At first attempts were made to meet such local failures by local measures, but the insufficiency of this proceeding was rapidly brought to light, and it came to be understood that a question of such general magnitude and importance could only be efficiently grappled with by a special organisation. It was thus that the Forest Department came into existence.

As a matter of course, it rested with the Government to show the lead, and the first step in the new direction was naturally to ascertain the extent of the forest property still remaining in the possession of the State, and in what measure such property was burdened by rights in favour of the peasantry. The Oriental Governments, from which the British Government inherited its forest property, never recognised the accrual of any prescriptive right; but, on the other hand, anybody was accustomed, without let or hindrance, to get what he wanted from the forest, to graze his cattle where he liked, and to clear jungle-growth for cultivation wherever he listed. This state of things, it is self-evident, did not permit of systematic forest management, and it became clear that a Forest Law and a Forest Settlement were urgently required. It was necessary that the Forest Settlement should define (*a*) the forests in which the ownership of the State was still absolute; (*b*) forests which were the property of the State, but which were burdened with legal rights, prescriptive or granted; and (*c*) forests, the property of individuals or communities, in which the State had rights over all or certain kinds of growing trees. After several local Rules and Acts had been introduced and had been in force for a longer or shorter time, the first Indian Forest Act was passed in 1865. This was, however, found wanting in many important respects, and was replaced by the Act of 1878. Even in this new Act, however, faults were at once recognised, and separate Acts were passed for Burma and Madras in 1881 and 1882 respectively.\* All three Acts provide for the formation of Government reserves and the settlements of rights within them; also for the constitution of village forests; and they contain forest police rules necessary for the protection of Government forests and forest-produce. The Indian Forest Act contains in addition provisions for the creation of protected forests. All three Acts provide for the control of Government over forests not belonging to the State, if such control appears necessary for the public weal, or if the treatment which such forests have received from their owners injuriously affects the public welfare or safety.

\* Copies of these Acts have been forwarded to the Exhibition.

More recently special Forest Laws for the newly-annexed province of Upper Burma and for Assam and Baluchistan have been passed by the Indian Legislature, and these contain several distinct improvements on the older Acts.

In the Central Provinces and Bengal, forest reservation had made rapid progress under the wise guidance of Sir Richard Temple, and large areas could at once be declared State forests under the Act of 1878. The rapid strides forest reservation has made in Bombay are due to the wisdom and foresight of the same eminent statesman. Other provinces are following the same line with more or less vigour, as may be gathered from the following table for 1891-92 :—

PROVINCES.	FOREST AREA, IN SQUARE MILES.				Proportion of Forests to whole area of Province.	REMARKS.
	Reserved.	Protected.	Unclassed.	Total.		
Bengal . . . .	5,211	2,181	4,531	11,926	8	
N.-W. P. and Oudh .	(a) 3,769	93	54	3,916	4	(a) Includes 78 square miles of leased forests.
Punjab . . . .	(b) 1,715	481	3,874	6,070	6	(b) Includes 343 square miles of leased forests.
Central Provinces .	19,680	...	393	20,073	23	
Burma (Lower) .	(c) 5,615	...	...	5,615	7	(c) Includes 461 square miles of taungya areas.
Burma (Upper) .	(d) 1,050	(e) 16,461	...	17,520	22	(d) Includes 113 square miles of taungya areas.
Assam . . . .	3,612	912	5,435	9,959	22	(e) Exclusive of the area of India-rubber forests, of which it is not possible at present to form an estimate even.
Coorg . . . .	113	743	...	856	51	
Ajmere . . . .	139	...	...	139	5	
Baluchistan . . . .	82	...	...	82	...	
Andamans . . . .	...	...	1,957	1,957	98	
Berar . . . .	2,261	...	2,175	4,436	25	
Total Bengal Presidency	43,256	20,871	18,422	82,549	12	(f) Includes 37 square miles of leased forests.
Madras . . . .	(f) 7,175	(g) 9,401	1,304	71,883	21	(g) Includes 154 square miles of leased forests.
Bombay * . . . .	10,170	4,319	...	14,489	11	
<b>GRAND TOTAL .</b>	<b>60,601</b>	<b>34,594</b>	<b>19,726</b>	<b>114,921</b>	<b>13</b>	

\* These figures are for 1890-91.

The organisation of the Forest Department was gradually developed at the same time under the energetic management of Sir Dietrich Brandis. The Department, of which the superior staff was reorganised in 1891, is divided into an Upper Controlling Staff (including Conservators, Deputy and Assistant Conservators), a Lower Controlling Staff (providing for Extra-Assistant and Extra-Deputy Conservators), a Protective Staff (composed of Rangers, Foresters, and Guards), and an Office Staff. The Upper Controlling Staff numbers at present 183 officers, of whom 63 per cent. have received a scientific training in forestry and were appointed in England by Her Majesty's Secretary of State. Most of these officers were trained in France, some in Germany ; but since 1885, the education of such officers has taken place at the Royal Indian Engineering College, near Windsor. The forest range is the unit of the present organisation, and the men intended for such charges, as well as those intended for employment in Native States or by wealthy native land-owners, are trained in the Imperial Forest School at Dehra Dun in the North-Western Provinces. Since the establishment of the School in 1878, 166 Rangers have been thus trained. The organisation of the Controlling Staff has been, as pointed out above, completed ; that of the Executive Staff, which must ultimately form the mainstay of forest administration in India, is now under the consideration of Government, and considerable additions to the existing numbers of Rangers, Foresters, and Guards will probably be made in almost every province.

The protection of forests in which, previously to the creation of the Forest Department, no restrictions of any kind existed, was, as may be supposed, a matter of the greatest difficulty. Boundaries were defined where no boundaries previously existed, or at least boundaries which had never formed a restriction had, under the Forest Law, to be respected. Previously, anybody might go into the forest, cut down in a most valuable portion all young trees over any extent of forest he wished, kill the mature ones and make a bonfire of the whole, sow in the ashes, reap a crop, and similarly destroy another area next year. A man wanting covering leaves for cigarettes might cut down a tree without let or hindrance ;

a cattle owner requiring more extensive pastures might fire and re-fire the forest till it became sufficiently open to yield a dense grass crop; cattle and even goats might graze and browse in the midst of forest reproduction. All this had to be stopped.

As regards general protection, the laws, being new, had to be worked leniently. This has been done, and the progress reported from time to time is satisfactory. Where forests suffer, especially under excessive grazing, they do so more from rights granted and privileges permitted during the time of settlement than from subsequent breaches of forest rules. The greatest benefit conferred lies in the stopping of the above-described method of cultivation, locally known as *kumi i, jhum* or *taungya*, in the Government forests of almost all provinces. This step affords, in the Central Provinces alone, protection to at least 5,000 square miles, which otherwise would have been rendered bare once in every fifteen to twenty years. In the protection of forests from fire there is still much to be learned and done, and in almost every province it is necessary to depend more on fire-tracing\* and fire-watching than on the help given by legislation. The law, while sufficiently stringent for reserves and even for protected forests, is quite inadequate to protect them from fires spreading into them from adjacent private forests and grazing-lands, and from open forests belonging to the Government, though the Burma Government has recently shown that most valuable results may be attained by insisting that the conditions of the law in regard to prairie fires shall be respected outside the forest areas. In all these classes of areas fires intentionally lighted still often occur, and spread wherever they find nourishment and wherever the wind may carry them. This, apart from the mere protection of the Government forests, is probably one of the most important questions connected with forestry, and consequently with agriculture, in India. These annual fires are the main reason of the barren condition of most of the Indian hill ranges, and are closely connected with

\* A map illustrating one of the systems of fire-protection employed is exhibited (*vide Appendix B to Part II*).

distress and famine. Many prejudices will have to be overcome in order to check this evil, and it will take the full power of Government to do so.

In the meantime practical steps have been taken to prevent the spread of external fires into the more valuable Government forests. During 1891-92, 24,000 square miles were thus protected from fire, at [a total cost of R2,42,000, and the following table gives a *résumé* of the work done:—

*Results of fire-protection in the forest circles administered by the Forest Department.*

CIRCLES.	TOTAL NUMBER OF ACRES.			Total cost. R	COST, IN PIES PER ACRE.	
	Attempted.	Failed.	Protected.		Attempted.	Protected.
Madras Presidency .	2,941,676	170,433	2,771,243	45,318	2·9	3·1
Bombay . . *	6,620,160	1,233,280	5,386,880	16,571	0·5	0·6
Bengal . . .	1,264,115	256,420	1,007,695	12,492	1·9	2·4
North-Western Provinces and Oudh . . .	1,741,033	61,797	1,679,241	48,714	5·4	5·6
Punjab . . .	189,916	23,594	166,322	2,106	2·1	2·4
Central Provinces . . .	2,476,395	185,008	2,341,387	52,191	4·0	4·3
Upper Burma . . .	682,320	553,770	128,550	805	0·2	1·2
Lower . . .	320,867	3,338	317,529	31,344	18·8	18·10
Assam . . .	730,556	88,556	642,000	19,483	5·1	5·8
Coorg . . .	130,715	16,274	114,441	5,290	7·8	8·9
Ajmere . . .	89,228	..	89,228	45	0·1	0·1
Berar . . .	727,943	7,753	720,190	7,780	2·0	8·1
TOTAL . . .	17,914,929	2,550,223	15,364,706	2,42,139	2·6	3·0

By fire-protection, the regulation of grazing, and the general protection of the forests, ample reproduction is ensured as a rule, after a shorter or longer period, in the more valuable forests of India, though, in some of the drier regions, areas thoroughly desolated and with unfavourable soil will resist improvement for the time being.

Most Indian forests are of a mixed character, containing only one or a few valuable species which repay the cost of working. Moreover, all age-classes are generally represented on the same area, and this necessitates working by selection (*Fr. jardinage*). It is self-evident that these facts make the problem of forestry—to secure a continuous yield proportionate to the stock on the ground without causing the deterioration of the forests—extremely difficult. In pre-

\* These figures are for 1890-91.

vious times the work was carried on haphazard, or based sometimes only on an exceedingly rough valuation of the growing stock. As a rule, however, the demand and requirements for forest-produce were the only considerations by which the exploitation was governed, and no attention was paid to the potential capabilities of the forests. Of late, however, more pretentious working-plans have been made, and several provinces have organised a division or staff for this work only. The working-plans made in the provinces under the Government of India are scrutinised and audited by the Inspector-General of Forests before they are passed by the Local Governments. The working-plans take special notice of all measures necessary to encourage and, what is infinitely more difficult in a mixed forest, to guide natural tree reproduction; and they prescribe any artificial means—such as girdling of inferior trees, dibbling in of seed, etc.—that are required to assist natural regeneration of the species or admixture desired.\* The forests controlled by the Department are, however, by far too extensive, and markets at high rate are not at present sufficiently general and secure to permit of the extensive use of the more elaborate methods of European sylviculture. In special connection with the preparation of working-plans, the Forest Survey Branch of the Imperial Survey Department has been formed. A list of the maps exhibited by the Forest Surveys appears as Appendix A to Part II of this handbook, where also a general account is given of the methods employed in Indian forest-surveying.

The exploitation of timber, at least of the more valuable timber, from Government forests, is carried out partly through the direct agency of the Department and partly by contractors. Of minor forest-produce, the most important at present are grass, hirda fruit (*Terminalia Chebula*) bamboos, cutch, cardamoms, eatechu, and lac; but there are many others of lesser value.

The estimated yield in timber and fuel, in cubie feet, of all Government forests was as follows during 1891-92:—

\* Specimen copies of a few Indian forest working-plans, and of other works and rules bearing on the exploitation of the forests, have been forwarded to the Exhibition.

GOVERNMENT AGENCY.		PUNCHAKERS.			RIGHT-HOLDERS.			FORE-RAENTS.			GRAND TOTAL.				
Timber,	Fuel,	Total.	Timber.	Fuel.	Total.	Timber.	Fuel.	Total.	Timber.	Fuel.	Total.				
c. ft.	c. ft.	c. ft.	c. ft.	c. ft.	c. ft.	c. ft.	c. ft.	c. ft.	c. ft.	c. ft.	c. ft.				
Bengal . . .	23,754	247,429	271,183	7,204,890	17,743,155	23,983,045	...	...	32,081	3,504,444	3,536,525	21,495,028	28,755,753		
N.-W. P., and Oudh.	574,507	1,819,769	2,394,676	2,020,011	2,457,523	4,477,534	395,644	1,541,142	1,936,786	1,214,083	1,854,851	3,068,934	4,204,645	7,573,285	11,877,930
Punjab . . .	634,381	2,610,509	3,244,890	485,223	1,159,906	1,645,129	427,458	25,146,848	25,574,306	833,968	50,820	884,788	2,381,030	28,963,083	31,349,113
Central Provinces	89,484	62,933	152,417	1,666,397	16,697,322	8,363,729	...	...	...	552	...	552	1,756,433	6,760,265	8,516,698
Burma (Upper).	256,843	...	256,813	6,926,292	1,457,798	8,384,090	...	48,800	48,800	169,350	...	169,350	7,352,485	1,506,598	8,859,083
Burma (Lower).	2,705,512	...	2,705,512	8,972,246	2,302,034	11,774,280	76,513	...	76,513	18,823	...	18,823	11,773,094	2,802,034	14,575,128
Assam . . .	73,472	5,502	78,974	1,625,873	194,662	1,820,535	...	...	...	546,945	2,408,824	2,955,769	2,246,290	2,608,988	4,855,278
Coorg . . .	83,251	...	83,251	312,487	196,000	508,487	...	...	...	3,106	...	3,106	398,844	196,000	594,844
Ajmere . . .	...	...	5,110	118,698	123,808	...	...	...	2,192	72,400	74,592	7,300	191,098	198,400	
Baluchistan . . .	2,522	17,634	20,156	3,592	134,954	138,552	2	...	2	...	...	...	6,122	152,588	158,710
Andamans . . .	341,674	816,174	1,157,848	36,700	4,462	41,162	...	...	37,500	330,000	367,500	415,874	1,150,636	1,566,510	
Berar . . .	...	...	615,122	1,558,341	2,173,463	...	...	...	6,332	...	6,332	621,454	1,558,341	2,179,755	
Madras . . .	266,546	1,806,320	2,072,866	2,722,596	12,179,502	14,902,098	...	...	97,795	1,351	99,146	3,086,937	13,987,173	17,074,110	
Bombay . . .	1,507,086	16,510,641	18,017,727	5,196,879	9,869,565	15,066,444	708	...	708	137,851	41,810	179,661	6,812,524	26,422,016	33,264,540
Total . . .	6,559,432	23,896,911	30,456,343	37,793,424	56,573,932	94,387,356	900,325	26,736,790	27,637,115	3,100,578	8,264,500	11,365,076	48,363,759	115,472,133	168,825,892

\* These figures are for 1890-91.

The following table exhibits information in respect of the sea-borne exports of forest-produce from India to foreign countries in 1891-92 :—

ARTICLES.	Quantity in tons of 20 cwt.; in the case of Teak. cubic tons.	VALUATION AT PORT OF SHIPMENT.	
		Total.	Per ton.
Caoutchouc . . . . . Tons	467	11,72,370	2,510
Shell-lac . . . . . "	5,514	60,67,924	1,100
Lac-dye . . . . . "	2	2,500	1,250
Sandal, Ebony and other ornamental woods . .	(Information not avail- able.)	8,41,938	...
Cutch and Gambier . . . . . Tons	9,853	31,72,992	322
Myrabolans . . . . . "	39,540	39,36,902	100
Teak . . . . . "	48,190	47,48,517	99
Cardamoms . . . . . "	124	3,18,957	2,572
Total in 1891-92 . .	...	2,02,62,100	...
" 1890-91 . .	...	1,77,40,556	...
Increase in 1891-92 . .	...	25,21,544	...

Arrangements have recently been made for the dissemination of information on these and other important Indian forest-products among the commercial community and other persons in Europe interested in the trade. Monographs on the more important products appear from time to time in the pages of the *Indian Forester*, and are subsequently republished in the series of penny hand-books issued by the Imperial Institute in London.

The financial results of Forest Administration in India have been as follow:—

QUINQUENNIAL PERIODS.		Revenue.	Expenditure.	Surplus.
		R	R	R
1864-65 to 1868-69 (annual average)	.	37,38,189	23,81,732	13,56,457
1869-70 to 1873-74	Ditto	56,25,693	39,89,632	16,36,061
1874-75 to 1878-79	Ditto	66,55,913	45,76,372	20,79,541
1879-80 to 1883-84	Ditto	87,84,514	56,07,652	31,76,862
1884-85 to 1888-89	Ditto	1,16,68,148	74,26,956	42,41,192
1889-90	.	1,53,03,572	80,12,518	72,91,054
1890-91	.	1,49,67,135	80,63,125	69,04,010
1891-92	.	1,53,63,706	86,23,852	67,39,854

## PART II.

### Brief Notes on the Exhibits.

For various reasons it was deemed inexpedient to attempt to procure for the Chicago Exhibition such complete and elaborate collections of Indian forest-produce as were seen at Paris in 1878, at Calcutta in 1883-84, and at Edinburgh in 1884. It was therefore arranged that the exhibits should be limited to (1) samples of the best Indian timbers in the rough and also fashioned, so as to show off their qualities ; and (2) other forest-produce of an established mercantile value, or otherwise of special interest outside the Indian Empire.

#### (i) Contributed by Inspector-General of Forests.

Carved mantelpiece of shisham (*Dalbergia Sissoo*), redwood, walnut, boxwood, and some fragments of very old timber (teak and blackwood) found in the ruins of Vijayanagar, near Bellary, in Madras, and in dock excavations at Bombay. The teak is about 600 years old, while the blackwood probably dates from before the Christian era. This carving was wholly designed by three Sikh carpenters (Harnám, Utam, and Gopál) and executed by them under the directions of the Inspector-General of Forests at "Ava Lodge," Simla.

## (ii) Contributed by Provincial Forest Departments.

**MADRAS.\***

## (a) TIMBERS.

**SOUTH ARCOT DISTRICT.**

1. *Acacia arabica*.—The wood very durable if well seasoned. Largely used for wheels, sugar and oil presses, rice-pounders, agricultural implements, and tool-handles. Weighs approximately 54 lbs. per cubic foot.

2. *Acacia leucophlæa*.—The wood is extremely hard. Seasons well and takes a good polish. Weighs 53 and 59 lbs. per cubie foot.

3. *Acacia Sundra*.—Seasons well, takes a fine polish and is durable. It is not attacked by white-ants. It is used for rice-pestles, oil and sugar-cane crushers, agricultural implements, etc. It has been found suitable for railway sleepers.

4. *Adina cordifolia*.—Seasons well, takes a good polish and is durable, but somewhat liable to warp and crack. Is used for turning and largely for furniture, agricultural implements, writing-tablets, etc.

5. *Albizzia odoratissima*.—The wood seasons, works, and polishes well, and is fairly durable. It is used for wheels, oil-mills and furniture. Weighs 54 lbs. per cubie foot.

6. *Albizzia Lebbek*.—A tree extensively met with on the plains and low hills of the Presidency. The wood is fairly durable, works and polishes well. It is used for sugarcane-crushers, oil-mills, furniture, wheelwork and boats.

7. *Anacardium occidentale*.—The wood is moderately hard, and is used for packing-eases, boat-building and charcoal. Weighs 38 to 39 lbs. per cubie foot.

8. *Anogeissus latifolia*.—Highly valued on account of its great durability and its suitability for agricultural implements, railway sleepers and ship-building.

9. *Rhizophora mucronata*.—Abundantly found in delta and tidal forests, and though contorted, is yet very strong and durable. A preparation is made from the ashes, which natives use for washing and cleaning cotton.

10. *Zizaniopsis officinalis*.—Very brittle, and is used only for firewood.

11. *Calophyllum inophyllum*.—Moderately hard, and is used for masts, spars, railway sleepers, etc. Weighs 42 lbs. per cubic foot.

\* Address of Conservators of Forests—

(i) Northern Circle—Pezvada.  
 (ii) Central " —Madras.  
 (iii) Southern " —Coimbatore.

12. *Cassia Fistula*.—Very durable, but rarely of sufficiently large size for timber. It makes excellent posts, and is used for carts, agricultural implements and rice-pounders.

13. *Chloroxylon Swietenia*.—Very hard and seasons well. Used for agricultural implements, cart-building, furniture and picture frames, and also for ploughs and oil-mills, and is found to stand water immersion well. It is also good for turning.

14. *Dalbergia latifolia*.—Valuable and extremely hard. Used for furniture, cart-wheels, agricultural implements and gun-carriages, and is esteemed for carving and fancy work.

15. *Gyrocarpus Jacquinii*.—Soft and used for making boxes and toys. It is preferred to all others for catamarans. Weighs 23 lbs. per cubic foot.

16. *Hardwickia binata*.—Very hard, extremely heavy and durable, but liable to split. Used for ornamental work, house-posts, etc. The tree grows in the dry forests, generally in isolated patches. Weighs 82 lbs. per cubic foot.

17. *Melia Azadirachta*.—Handsomely marked, and polishes well; but is liable to split and warp. It is used for making carts, in ship-building and for agricultural implements. It is held sacred by Hindus, and idols are made of it.

18. *Morinda citrifolia*.—Moderately hard and durable, and used for making small furniture, plates and dishes.

19. *Pterospermum suberifolium*.—Light red, moderately hard. It is used for building carts and other purposes.

20. *Pterocarpus Marsupium*.—Very hard and durable. Seasons well and takes a fine polish. It is much used for doors and windows, frames, posts and beams, furniture, agricultural implements, cart and boat-building. It has also been used for railway sleepers.

21. *Shorea laccifera*.—A large tree. Wood very to extremely hard, and much used for house-building.

22. *Strychnos Nux-vomica*.—A hard wood, is close-grained, but is apt to split and warp. It is used for carts, agricultural implements and fancy cabinet-work. Weighs 57 lbs. per cubic foot.

23. *Strychnos potatorum*.—Wood hard, close-grained and seasons well. It is used for buildings, carts and agricultural implements. The ripe seeds are used by natives to clear muddy water. Weighs 57 lbs. per cubic foot.

24. *Terminalia Arjuna*.—This wood is used for carts, agricultural implements, boats, and for buildings. It is apt to split in seasoning and is not easy to work. Weighs 57 lbs.

25. *Terminalia Chebula*.—The wood is fairly durable and takes a good polish. It is used for furniture, carts, agricultural implements and house-building.

26. *Thespesia populnea*.—A durable wood, used for gun-stocks, boats, cart and carriage-making, and furniture. Weighs 50 lbs. per cubic foot.

27. *Wrightia tinctoria*.—This tree is common in the plains and low hills. Wood moderately hard, close-grained, and is used for carving and turning. Weighs 49 lbs. per cubic foot.

28. *Zizyphus Jujuba*.—Wood hard. It is used for saddle-trees, agricultural implements, oil-mills, etc. Weighs 43 to 52 lbs.

#### *SOUTH MALABAR DISTRICT.*

1. *Artocarpus hirsuta*.—A durable wood which seasons well. Much used for house- and ship-building purposes, and furniture. Weighs 34 lbs. per cubic foot.

2. *Calophyllum tomentosum*.—This timber yields good spars, and is used for building and bridge-work. Weighs 35 lbs. per cubic foot.

3. *Cedrela Toona*.—A durable and highly valuable timber, not liable to the attacks of white-ants. Largely used for furniture of all kinds and carving.

4. *Diospyros Ebenum*.—Used for inlaying and ornamental turnery. Weighs 61 to 70 lbs. per cubic foot.

5. *Hopea parviflora*.—Wood of good quality, and may be useful for railway sleepers; valued much for building native temples. Weighs 62 to 63 lbs. per cubic foot.

6. *Lagerstræmia microcarpa*.—A moderately hard timber, used for ship-building, furniture, etc.

7. *Tectona grandis*.—Durable and does not split, crack, or warp when once seasoned, and is rarely attacked by white-ants. It is used largely for ship-building and construction of railway carriages, furniture, etc. Weighs about 40 lbs. per cubic foot.

8. *Terminalia tomentosa*.—Wood largely used for house-building, ship- and boat-building, carts, etc. It splits very much unless thoroughly seasoned.

#### *NELLORE DISTRICT.*

1. *Bauhinia racemosa*.—A hard wood, but not in much local demand. Weighs 50 lbs. per cubic foot. Strong ropes are made from the bark stripped from the green branches.

2. *Erythroxylon monogynum*.—Timber hard, and used as a substitute for sandalwood. Weighs 55 to 67 lbs. per cubic foot.

3. *Mimusops Elengi*.—Used for house-building, carts and cabinet-work. Weighs 60 lbs. per cubic foot.

4. *Mimusops hexandra*.—A tough, even-grained and durable timber, used for sugar-mills, beams, oil-presses, house-posts and for turning.

5. *Shorea Tumbuggaia*.—Wood useful for house-building, particularly for door-frames, posts and rafters. Weighs 64 lbs. per cubic foot.

6. *Vitex altissima*.—Wood hard, close-grained, and polishes well. Used for buildings and carts.

#### *MADURA DISTRICT.*

1. *Acrocarpus fraxinifolius*.—This wood is used for tea-boxes and planking, and for buildings, furniture and shingles. Weighs 39 lbs. per cubic foot.

2. *Artocarpus integrifolia*.—A moderately hard wood, seasons well and takes a fine polish. It is largely used for carpentry, boxes and furniture.

3. *Canarium strictum*.—A soft wood, used in the construction of tea-boxes. The tree yields a resin which is used as incense.

4. *Schleichera trijuga*.—Wood strong and durable, used for oil, sugar and rice mills, and for agricultural implements and carts.

#### *NILGIRI DISTRICT.*

1. *Grewia elastica*.—A tough and elastic timber, used for shoulder-poles, bows, spear-handles, etc., splits well, and is sometimes used for roofing-shingles. Weighs 48 lbs. per cubic foot.

2. *Mesua coromandeliana*.—Wood very hard, weighing from 74 to 76 lbs. It is used for buildings, bridges and tool-handles. Its general use is prevented by its great hardness, weight, and the difficulty of working it.

3. *Odina Wodier*.—A moderately hard wood, seasons well and does not warp. It is used for spear-shafts, scabbards, wheel-spokes, cattle-yokes, oil-presses and rice-pounders. It might be good for cabinet-work.

4. *Santalum album*.—It is an important article of trade, and is transported largely to China and Arabia. It is well suited for engraving and carving. It is also used for incense and perfume. Weighs 61·5 lbs. per cubic foot.

#### *KURNOOL DISTRICT.*

1. *Aegle Marmelos*.—Wood strong, with an aromatic scent when freshly cut. It is used for the pestles of oil and sugar mills, naves of carts, etc.

2. *Eugenia Jambolana*.—A moderately hard wood and seasons well. It is used for building, agricultural implements, and also for well-works, as it resists the action of water.

3. *Pterocarpus santalinus*.—Wood extremely hard, used for building purposes and for turning. Weighs from 76 to 77 lbs. per cubic foot.

4. *Soymida febrifuga*.—Durable, not liable to be much attacked by white-ants. It is used for construction, well-work, ploughshares and oil-mills. Weighs 73·5 lbs per cubic foot.

5. *Terminalia belerica*.—This wood is used for packing-cases, coffee-boxes, catamarans and grain-measures. Weighs 48 lbs per cubic foot.

*CUDDAPAH DISTRICT.*

1. *Ailanthus excelsa*.—A soft wood, used to make floats for fishing, sword-handles, spear-sheaths and catamarans; weighs 28lbs. per cubic foot.

*NORTH ARCOT DISTRICT.*

1. *Albizzia amara*.—Timber strong, fibrous and stiff, close-grained, hard and durable. Superior to sal and teak in traverse strength and direct cohesive power. It is used for beams of native houses and carts.

2. *Alangium Lamarckii*.—Hard, close and even-grained. It is used for pestles, oil-mills, wooden cattle-bells, etc., and is valuable as fuel.

3. *Anogeissus acuminata*.—Wood warps and cracks in seasoning, and is not very durable, especially when exposed to water. Used for buildings.

4. *Bassia longifolia*.—A very flexible and durable wood, valued for ships' keels, for trenails and for planking below the water-line. It is also used for carts, furniture and bridge construction.

5. *Bombax malabaricum*.—Wood not durable, except under water, when it lasts tolerably well. It is used for planking, packing-cases and tea-boxes, toys, scabbards, etc.

6. *Casuarina equisetifolia*.—The wood is very hard and heavy, and difficult to cut. It has been largely planted in this Presidency for fuel, for which it is excellent.

7. *Mangifera indica*.—Used for planking, doors and window-frames, packing-cases, indigo-boxes; canoes and masula boats are also made of it.

8. *Tamarindus indica*.—A highly-prized wood, though extremely difficult to work. It is used for wheels, mallets, planes, furniture, rice-pounders, oil and sugar mills, and is excellent for turning.

## (b) DYES AND TANS.

1. *Acacia leucophleba*.—The bark is used for dyeing, and gives a red colour, but mixed with other barks gives black. Selling price R1-8 per cwt.

2. *Cassia auriculata*.—Bark most valuable for tanning, and is used also, like myrabolams, to modify dyes. It is said to give a buff colour to leather. Selling price R40 per ton.

3. *Cassia Fistula*.—The bark is used in tanning, chiefly along with *Terminalia*. A light-red dye is obtained with alum as a mordant. Selling price R1-8 per cwt.

4. *Terminalia Chebula*.—The fruit is the well-known myrabolam of commerce. Unripe fruit is used in tanning, dyeing, and in medicine. The fruits give with alum a yellow dye, and with ironclay a good ink. Astringent galls form on the young twigs, which are also used for ink and in dyeing and tanning. Selling price R1-3 a maund.

5. *Ventilago maderaspatana*.—The bark is used along with chay root (*Oldenlandia umbellata*) to produce a chocolate colour often seen on the borders of native cloths. Selling price R2 to R3 a maund.

6. *Acacia mollissima*.—Bark extensively used for tanning in Australia and Europe, but is not now used by the local tanners, who prefer that of *Cassia auriculata*.

7. *Mallotus philippensis*.—The powder of the fruit (kamlapodi) is used as a dye all over India, especially for silk, to which it imparts a fine yellow colour. It is rarely used for cotton. To spirit it gives a rich deep orange inclining to red. Neither spirit nor alkaline solution dissolves it. Alum added to the alkaline infusion renders the colour more bright and permanent.

8. *Oldenlandia umbellata*.—The root (chay) holds the same place amongst Indian dye-stuffs as madder in Europe. For producing the brilliant and fast-red dye for which Madras handkerchiefs were once famous, this root is used along with *Morinda* and alum as a mordant. When employed with *Ventilago*, it gives the chocolate colour formerly so much prized in the Bandana or Pulicat handkerchiefs. With iron, the chay gives a black; and with saffron, lime-juice, and soda an unstable red colour. Selling price R25 per candy.

9. *Anogeissus latifolia*.—The leaves yield a black dye and are useful in tanning. Selling price R50 per ton.

10. *Morinda citrifolia*.—The bark of the root is largely used for dyeing red and yellow. Selling price R30 per ton.

11. *Terminalia Chebula*.—The bark is used for tanning and dyeing. Selling price R50 per ton.

12. *Acacia arabica*.—The bark and pods, with alum as the mordant, yield dark-brown shades approaching to black. The bark is highly astringent and is used by tanners and dyers.

13. *Acacia Catechu*.—Catechu is obtained by boiling down the wood cut into chips and is largely exported to Europe for tanning and dyeing. Selling price 4 annas per lb.

14. *Bixa Orellana*.—The seed-pulp gives a beautiful flesh colour, largely used in dyeing silks. It is used to colour cheese and other edible articles. Selling price 2 annas 8 pies per lb.

15. *Butea frondosa*.—The flower, called "tesu," yields a brilliant but fleeting yellow dye much used by the natives. The dye is extracted either by pressing the coloured sap of the fresh flowers or as a decoction or infusion from the dried flowers. Selling price 1 anna 4 pies per lb.

16. *Carthamus tinctorius*.—The flower is powdered and used with the chay root for dyeing various shades of pink and red. Selling price 3 annas 4 pies per lb.

17. *Cassia Tora*.—Seeds used by native dyers along with indigo for dyeing blue.

18. *Cesalpinia Sappan*.—Wood yields a valuable red dye. Chips of wood steeped in water yield a red colour, and in combination with other substances yield different colours. Selling price 1 anna 6 pies per lb.

19. *Coscinium fenestratum*.—Wood contains much colouring matter, akin in its properties to that of turmeric. It produces a yellow dye.

20. *Indigofera tinctoria*.—Most valuable dye-stuff and the only one which produces blue colour. Indigo produces green with turmeric or gamboge, and black with iron. Selling price R1-10-8 per lb.

21. *Lawsonia alba*.—Leaves are powdered and made into a paste, which produce the dye known as henna. It is used by the natives for colouring the nails, skin and beard.

22. *Mimusops Elengii*.—The bark is used for dyeing shades of brown.

23. *Nyctanthes Arbor-tristis*.—The corolla tubes of the flowers are orange-coloured, and when severed from the limbs give a beautiful but fleeting orange or golden dye which is mostly used for silk, sometimes in combination with turmeric. Selling price 13 annas 4 pies per lb.

24. *Pterocarpus santalinus*.—Wood exported from Madras in billets and root-pieces as a dye-wood, as it contains a red colouring principle (Santalum) which is soluble in alcohol and ether, but not in water. Dissolved in alcohol, it dyes cloth a beautiful salmon-pink colour. Selling price 2 annas 8 pies per lb.

25. *Punica Granatum*.—Flowers are very handsome and give a light-red dye. The bark and the rind of the fruit are used for tanning and for dyeing morocco leather. Selling price R1-4 and 2 annas 8 pies per lb. respectively.

26. *Rubia cordifolia*.—The colour obtained from the root (manjiti) is bright, though not so durable as that of European madder. Selling price 3 annas 4 pies per lb.

27. *Semecarpus Anacardium*.—The nut is blackish and contains a dark, viscid, most acrid juice, which is used in conjunction with lime for marking cotton clothing like marking-ink.

28. *Tamarix gallica*.—The galls have the same properties as oak-galls, and serve the same purpose in dyeing various colours.

29. *Tamarindus indica*.—An infusion of the leaves is said to give a green colour to silk previously dyed with indigo.

30. *Terminalia belerica*.—Fruit is one of the myrobalams used in dyeing cloth and tanning leather.

31. *Terminalia tomentosa*.—Bark is used for dyeing black. Selling price 3 annas 4 pies per lb.

32. *Toddalia aculeata*.—The root-bark contains a yellow colouring matter. Selling price 2 annas 8 pies per lb.

(c) SUBSTANCES YIELDING OIL.

1. *Anacardium occidentale*.—The nuts are roasted and eaten. They also give by expression a yellow oil similar to almond oil. The pericarp of the fruit gives a black, aerid oil called cardol, and an acid (anacardic acid). The oil is very caustic, raises blisters, and is used for warts, corns and ulcers. It is also used to prevent the attacks of insects. The enlarged pedicels of the fruit are eaten.

2. *Argemone mexicana*.—A pale-yellow, clear, limpid oil is obtained from the seeds, which is used for burning in lamps, and is given medicinally for ulcers and eruptions.

3. *Citrullus colocynthis*.—Seeds yield a clear, limpid oil used for burning in lamps and is also used as a hair-dye.

4. *Melia Azadirachta*.—A fixed, aerid, bitter oil, deep yellow, and of a strong disagreeable flavour, is extracted from the seed by boiling or pressure. It is employed medicinally as an anthelmintic and antiseptic, and is also considerably used by the poorer classes for burning in lamps, but is said to smoke offensively.

5. *Jatropha Curcas*.—The seeds yield an oil used for burning; in medicine as a purgative and emetic and as an application in cutaneous diseases.

6. *Pongamia glabra*.—The seeds give a thick, red-brown oil; used for burning and medicinally as an application for skin diseases, for which it is said to be very efficacious.

7. *Sapindus trifoliatus*.—A semi-solid oil is extracted from the seed-kernel and is used medicinally.

8. *Terminalia belerica*.—An oil is obtained from the kernels which is used for the hair.

9. *Moringa pterygosperma*.—Seeds yield an oil similar to the “ben oil” of watch-makers. The root-bark smells like horse-radish.

10. *Calophyllum inophyllum*.—The fresh seeds when shelled yield a large quantity of fragrant, dark-green oil, which varies in colour from greenish yellow to deep green, and is used for lamps and for caulking vessels. It is known in Europe as “domba oil.” Selling price R10 per ton.

(d) GUMS AND RESINS.

1. *Acacia arabica*.—This tree yields a transparent gum, which is a substitute for gum arabic. Acacia gums are sometimes used in calico-printing, but for this purpose they are inferior to gum tragacanth, as

they lack glossiness and are too brittle. This gum is also used medicinally. Selling price annas 2 per lb.

2. *Anogeissus latifolia*.—It yields a gum which is extensively used in calico-printing. Occurs in clear straw-coloured, elongated tears adhering into masses; sometimes honey-coloured or even brown from impurities. As an adhesive gum, it is inferior in strength to gum arabic. Selling price annas 2 per lb.

3. *Albizzia Lebbek*.—Yields a gum which is said not to be soluble in water but merely to form a jelly. It resembles gum arabic, and is used as an adulterant for pure gum arabic in calico-printing and in the preparation of gold and silver leaf cloths.

4. *Feronia Elephantum*.—The tree yields a large quantity of a clear, white gum, much resembling gum arabic. It is used by dyers and painters, particularly by miniature and chintz-painters; it is also employed in making ink and certain varnishes and by bricklayers in preparing a fine kind of whitewash.

5. *Canarium strictum*.—The resin (black dammer of commerce) is used in the manufacture of varnish and mostly as a substitute for burgundy pitch, and also in medicine. Selling price 1 anna and 9 pies per lb.

6. *Pterocarpus Marsupium*.—The tree yields, from wounds in the bark, a red gum-resin called "kino," a valuable astringent much used in medicine. Selling price R4 a maund.

(e) FIBRES.

1. *Hardwickia binata*.—The fibre obtained from the inner layers of the bark is slightly woolly and of a brownish colour. It is strong and used in the manufacture of ropes. Selling price R44 a ton.

2. *Abutilon indicum*.—The stems contain a good fibre suitable for cordage.

3. *Aloe indica*.—The leaves yield a useful fibre. Selling price R1 a maund.

4. *Ananas sativa*.—The most important use of the pine-apple plant consists in the fine white fibres yielded by the leaves. These have been formed into the most delicate fabrics, as well as fishing-lines, ropes, etc.

5. *Aristida setacea*.—From the root-fibres of this broom-grass, weavers' brushes are made.

6. *Borassus flabelliformis*.—The fibre extracted from the leaf-stalks is used for rope and twine-making, and may also be used for paper. This fibre is strong and wiry. The ropes and string made of it are largely used for cattle-yokes and other agricultural purposes.

7. *Calotropis gigantea*.—The inner bark gives a valuable fibre of fine silky texture, which is very strong and is used for bow-strings, fishing nets and lines; it is found to be durable in water.

8. *Crotolaria juncea*.—Extensively cultivated all-over India for its fibre, which is largely used for cordage, fishing-nets, canvas, paper, gunny-bags, etc. Selling price Rs 2 a maund.

9. *Hibiscus Abelmoschus*.—The stem yields a strong fibre.

10. *Musa paradisiaca*.—The fibre of the plantain has long been used by the natives of India for cordage purposes, for mats and, to a smaller extent, for coarse paper.

11. *Pandanus odoratissimus*.—The aerial roots yield a strong fibre, which is used for various purposes. The roots are made into brushes and are used by bricklayers for whitewashing houses.

12. *Sansevieria Roxburghiana*.—From the succulent leaves is extracted a beautiful, soft, silky fibre, held in high esteem by the natives on account of its elasticity and its consequent suitableness for bow-strings. The fibre is much valued in Europe for ropes used in deep-sea dredgings, and it also makes a very superior paper.

13. *Sida rhomboidea*.—The plant yields a fine white fibre.

14. *Urena sinnata*.—The fibre is manufactured by simple maceration, and very good gunny-bags are made from it.

15. *Yucca gloriosa*.—Yields an excellent fibre for paper.

16. *Phænix sylvestris*.—The fibrous leaflets and the fibre from the petioles are made into mats, ropes, and baskets.

17. *Bauhinia racemosa*.—A strong fibre is made from the inner bark, used for cordage, but is not durable in water. Selling price 6 pies a yard.

18. *Bauhinia tomentosa*.—A fibre is prepared from the bark. Selling price 6 pies a yard.

19. *Agave americana*.—The leaves yield an excellent fibre suitable for cordage, mats, ropes, etc., and the tow in the manufacture of paper. Selling price Rs 1 a maund.

20. *Grewia lœvigata*.—This tree yields a fibre suitable for cordage. Selling price Rs 1 per maund.

## BOMBAY.\*

### (a) TIMBERS.

1. *Adina cordifolia*, (Rs 70 per ton in Bombay).

2. *Albizzia odoratissima*, (Rs 60).

3. „ *procera*, (Rs 60).

\* Address of Conservators of Forests—

(i) Northern Circle—Surat.  
 (ii) Central „ Poona.  
 (iii) Southern „ Belgaum.  
 (iv) Sind „ Hyderabad.

4. *Augeissus latifolia*, (R60).
5. *Bauhinia Vahlii*, (R100).
6. *Calophyllum Wightianum*, (R90).
7. *Dalbergia latifolia*, (R100—200).
8. *Eriolæna Candollei*.
9. *Gmelina arborea*, (R60).
10. *Grewia tiliæfolia*, (R70).
11. *Heterophragma Roxburghii* (R70).
12. *Lagerstræmia microcarpa*, (R70).
13. *Odina Wodier*, (R50).
14. *Ougeinia dalbergioides*.
15. *Pterocarpus Marsupium*, (R100).
16. *Stephegyne parvifolia*, (R70).
17. *Stereospermum xylocarpum*, (R50).
18. " *chelonoides*, (R60).
19. *Tectona grandis*, (R100 to 200).
20. *Terminalia paniculata*, (R70).
21. " *tomentosa*, (R70).
22. *Vitex altissima*, (R100).
23. *Xylia dolabriformis*, (R70).
24. Carpenter's mallet of babul.
25. Maul and peg of babul, steel-bound.
26. Babul felloes.
27. Six hogspears on bamboo shafts.
28. Cane picnic basket.
29. Carved teak easel.
30. Map of Singarh forests near Poona.
31. Water-colour picture (framed) by Colonel Hutchinson. Subject—  
Singarh hill-fort from Lake Fife.
32. Indian clubs of *godi*, (*babul*) wood.
33. Indian clubs of *arjun* wood.
34. Indian clubs of *bor* wood.
35. Indian clubs of *khadsing* wood.
36. Carved blackwood picture frame.
37. Carved blackwood picture frame, with photograph of snake and monkey.
38. Carved blackwood teapoy.
39. Carved blackwood teapoy.
40. Carved blackwood flower-pot stand.
41. Carved blackwood flower-pot stand.
42. Set of six elephants carved in ebony.
43. Carved sandalwood glove-box.
44. Carved sandalwood handkerchief-box.

45. Carved sandalwood photograph frame.
46. Carved jackwood (*Artocarpus integrifolia*) picture-frame, with photograph.
47. Carved bhendi picture-frame, with photograph.
48. Carved Belgaum walnut (*Aleurites moluccana*) frame.
49. Carved ebony picture-frame, with photograph by Mr. Woodrow.
50. Surat cart, showing different timbers used.
51. Semi-circular saw.

(b) OILS AND RESINS.

52. Oil of kokam (*Garcinia iudica*).
53. Oil of sandalwood (*Santalum album*).
54. Rusa oil (*Andropogon Schænauthus*).
55. Ditto (*Andropogon Nardus*) citronella.
56. Ditto unrectified.
57. Ditto ditto.
58. Kaju oil (*Anacardium Occidentale*).
59. Nim oil (*Melia iudica*).
60. Karanj oil (*Pongamia glabra*).
61. Ditto unrectified.
62. Dolia oil (*Bassia latifolia*) from the kernel of the mowra fruit.
63. Ditto ditto ditto.
64. Aoli oil (*Phyllanthus Emblica*).
65. Kosim oil (*Schleichera trijuga*).
66. Kardai oil (*Argemone mexicana*).
67. Lac, stick.
68. Lac, button.
69. Lac, shell.
70. Kath or cutch, or catechu.

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## NORTH-WESTERN PROVINCES AND OUDH.

*CENTRAL CIRCLE.\**

(a) GUMS OR RESINS.

1. *Bauhinia Vahlii*.—Maljan gond, a medicinal tonic.
2. *Bauhinia retusa*.—Semla gond, used in confectionery. (The roots yield a carminative.)
3. *Buchanania latifolia*.—Katbilawa gond, medicinal remedy for dysentery.
4. *Butea frondosa*.—Dhak gond, a clear ruby-coloured astringent gum, said to contain 73 per cent. tannin, 22 per cent. gallic acid, etc.; a remedy in dysentery. The “Bengal Kino” of commerce.

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\* Address of Conservator of Forests—Naini Tal.

5. *Acacia catechu*.—Khair or kath. The cutch of commerce. Used as a dye, specially in calicos. It is said to contain a larger percentage of tannin than any other astringent and is preferred to No. 4. Used also as a tanning agent and medicine.

6. *Zizyphus Jujuba*.—Ber gond, medicinal, a febrifuge.

(b) BARKS.

7. *Bauhinia Vahlii*.—Maljan, a tanning agent; also used in the manufacture of an excellent fibre for ropes, paper-making, etc.

8. *Symplocos crataegoides*.—Lodh, a yellow dye, and an astringent in medicine.

9. *Acacia catechu*.—Khair or kath, a tanning agent.

(c) FRUITS AND SEEDS.

10. *Buchanania latifolia*.—Katbilawa or chironji, the kernels of which are used in confectionery, or are parched and eaten. Resemble pistachio nuts.

11. *Aegle Marmelos*.—Bel, the fruit of which, dry or green, is a perfect specific in cases of diarrhoea or early in cases of dysentery, and is also much used in native cements in building, etc.

(d) Roots.

12. *Berberis aristata*, etc.—Rasaut, a yellow dye, specially valuable for leather; the bark is also used in medicine as a tonic and as a lotion in cases of ophthalmia.

*OUDH CIRCLE.\**

*Kheri Forests.*

TIMBERS.

1. *Shorea robusta*.—Sâl, a dark reddish-brown, very hard, heavy, strong and rough wood, weighing 50—60 lbs. per cubic foot. It is largely used for building purposes, joists, beams, scantlings, etc., and extensively so for sleepers, many hundreds of thousands of which have been supplied from these forests. For the above purposes it is one of the most important woods in northern India.

2. *Dalbergia Sissoo*.—Shisham or sissoo, a hard elastic wood, seasons well, does not warp or split, and takes a fine polish. It is much esteemed for all purposes where strength and elasticity are required. Weight 45—50 lbs. a cubic foot. Colour light to dark brown. Largely used for doors, windows, and is specially suited for furniture.

3. *Ougeinia dalbergioides*.—A strong, tough, durable, close-grained and hard wood, which takes a fine polish. It is of a light yellow-greenish

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\* Address of Conservator of Forests—Lucknow.

colour, and weighs 57—60 lbs. per cubic foot. Used for wheelnaves, furniture, for building purposes and for agricultural implements.

### Bahraich Forests.

#### (a) TIMBERS.

1. Slab of ebony (*Diospyros Melanoxyton*). Selling price about Rs 2 per cubic foot.
2. Slab of *Ougeinia dalbergioides*. Prized locally for ornamental work.
3. Slab of *Stereospermum suaveolens*.

#### (b) GRASS.

4. *Ischaemum angustifolium*.—Locally exported for paper manufacture and rope-making. The fibre is strong and easily bleached.

### Gonda Forests.

#### (a) TIMBERS.

- (1) *Anogeissus latifolia*—(dhau)—used for axles of carts, handles, etc.
- (2) *Schleichera trijuga*—(kusum)—used chiefly for oil and sugar-cane crushers.

#### (b) FLOWERS, FRUITS, AND SEEDS.

- (3) Flower of mowha (*Bassia latifolia*), used for distilling country spirit.
- (4) Seeds of mowha (*Bassia latifolia*).
- (5) Fruits of harra (*Terminalia Chebula*) are the black myrobolams used in tanning, dyeing, and in medicine.
- (6) Fruits of bahera (*Terminalia bellerica*), used as for No. 5.
- (7) Fruits of ounla (*Phyllanthus Emblica*), used as for No. 5.

### Gorakhpur Forests.

#### TIMBERS.

- (1) *Adina cordifolia*.
- (2) *Bassia latifolia*.
- (3) *Albizzia Lebbek*.
- (4) *Pterocarpus Marsupium*.

### SCHOOL CIRCLE\*

#### (a) RESINS AND OILS.

1. Resin from *Pinus longifolio*} The two pines from which these
2. " " " " *excelsa*} samples have been obtained are common in the Jaunsar Division of this Circle, the division under which come the forests of the hill-country between the Jumna and its

\* Address of Conservator of Forests—Dehra Dún.

tributary the Tons. In the Jaunsar forests, the long-leaved pine (*Pinus longifolia*) is found from the river-beds up to about 6,000 feet and occasionally higher, the chief forests being, however, on the lower slopes of the valleys. The blue-pine (*Pinus excelsa*), on the other hand, is found in the upper hills, where it is associated with firs and oaks, and especially with deodar. For the woods of these two trees, however, the demand is somewhat limited, and beyond a certain distance from the main flowing streams, it is very small. Consequently during the last ten years much discussion has taken place and many experiments have been made, in order to endeavour to utilize these trees for the supply of resin and turpentine to the plains country below. Both products are very largely used, especially in the manufacturing towns, and hitherto the supply has almost entirely come from America.

An endeavour was made at Dehra Dún in 1890 to turn out as good a quality as possible of both resin and turpentine. The crude resin is collected by tapping the trees in the hills in a manner similar to that used in the *Pinus maritima* forests in France, viz., by slicing off the bark and part of the sapwood in two or three longitudinal grooves in the tree trunk. The resulting crude resin oozes out and trickles into a pot placed to receive it, which is occasionally cleared out and the resin collected in tins. The crude resin is turned out of the tins into an iron pan which is heated and the melted stuff filtered to remove dead leaves, pieces of bark and other impurities. It is then placed in a boiler with a small quantity of warm water, and each charge takes then about 12 hours in distilling. A small quantity of water is gradually admitted, and in the distillation the water and turpentine oil pass off through condensers into a jar, where they separate from each other by gravitation. When the oil ceases to flow, the boiling is stopped and the resin turned out of the boiler into moulds, where it dries (see Exhibits Nos. 1 and 2). The oil of turpentine is filtered to clear it and stored in iron cylinders for sale. The outturn of one still yearly is about 200 maunds (143 cwt.) of resin, and 230 gallons of oil of turpentine. The resin is sold at R5-8-0 per maund, almost entirely to the soap-makers at Meerut; and the turpentine at R2-8-0 per gallon to various purchasers, yet the demand has not become sufficiently good. The above quantities are given by about 280 maunds (200 cwt.) of crude resin. The net profit is about R5 per maund of crude resin. There can be little doubt that by degrees the market will improve and a much larger business done, but it is hoped that the works set on foot by the Government will attract capital, and that the crude resin will be sold in the forests and the manufacture done wholly by private enterprise, which will make of the business the useful industry it ought to be.

3. Oil of Turpentine.—See under Exhibits Nos. 1 and 2.

4. Pitch from the chir pine (*Pinus longifolia*).—On the banks of the larger rivers in this Circle, and especially of the Tons, large numbers of trees of the long-leaved pine are sold for conversion into rafter-pieces for export to the plains, the stumps remaining in the forests. The want of a good supply of tar for local forest-works led to the idea of manufacturing it from these stumps, and consequently rough masonry kilns have been erected in two or three localities. The wood full of resin is cut into small billets and placed in the kilns, which are then fired as if for charcoal-making. The tar which oozes out in distillation collects in a funnel at the bottom, and thence runs out into vessels placed ready. This tar is a viscous fluid of a dark-brown colour, and can be used in the rough, but for export it is best converted, by boiling down, into pitch.

5. Oil of Deodar (*Cedrus Deodara*).—Just as tar is obtained from the refuse wood of the long-leaved pine, so, and with almost exactly the same system, is the oil of deodar produced. It is a dark, strong-smelling liquid, employed for coating the inflated skins which are used by river-side people, and also as a medicine for outward application for horses, cattle and camels, and as a preventive to the bites of the “potú” fly, which is such a scourge of the deodar forests. It is said to be an excellent antiseptic, and deserves to be better known and possibly to obtain a considerable demand.

#### (b) GRASS.

6. Bhabar Grass (*Ischænum angustifolium*).—This grass, which is extensively found on the dry hills (Siwaliks) parallel to the Himalayas, as well as on the southern slopes of the lower Himalayan spurs, is a very important article of local forest-produce. It is used to make strong and durable ropes, for brooms, and, above all, for paper-making. The supply is very large, and all that is required to increase the demand is for the paper-mills to be rather nearer the producing forests. The grass is cut annually and reproduces itself at once, so that the yield is permanent.

## CENTRAL PROVINCES.

### NORTHERN CIRCLE \*

#### (a) TIMBERS.

1. *Tectona grandis* (teak).—This is a specimen of the wood from the tree as it grows in the districts of Mandla, Jubbulpore, Damoh, Saugor, and Narsingpur in the Central Provinces, which districts are within the northern limits of its range. The wood is richly grained and works up easily. It is used for household furniture, for which purpose it is peculiarly well adapted. The tree does not in these provinces attain

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\* Address of Conservator of Forests—Jubbulpore.

a large size when found on the extreme limits of its range. Logs varying from  $2\frac{1}{2}$  to 3 feet in girth and from 10 to 15 feet in length are about the average size procurable. It is estimated that 11,000 tons of this class of wood is procurable from the Government forests annually. Its price would range from 12 annas to R1-4 per cubic foot delivered on a line of railway.

2. *Cordia Macleodii*.—This wood is light, tough, and elastic, possesses considerable durability, and is obtained from a small tree which rarely exceeds 3 feet in girth with a clear bole exceeding 6 to 8 feet. It is nowhere abundant, but is sparsely distributed in the mixed forests of the Central Provinces. It is estimated that annually 8,000 cubic feet of this wood could be procured from the State forests of this Circle at prices varying from R1 to R1-8 per cubic foot delivered along the railway. The wood is much esteemed by the natives, and used by them for making furniture and agricultural tools.

3. *Briedelia retusa*.—Is also a small tree, widely distributed, but in no single locality abundant. Never gregarious, but is found associated with other species of similar habit on moist lands. The wood is much prized for its beauty when properly worked up. Used for furniture and cabinet-making.

4. *Schrebera swietenioides*.—Locally abundant in some of the drier forests in the Central Provinces. Is a small tree rarely exceeding 4 feet in girth at base, with a stem of 12 to 20 feet in length. The wood is handsomely streaked with red on a hard grey ground. Might be found useful in the arts and for the manufacture of furniture. It is estimated that about 12,000 cubic feet could be obtained annually from the State forests in the Northern Circle at prices varying from 12 annas to one rupee per cubic foot delivered along a line of railway.

5. *Grewia tiliæfolia*.—A small tree widely distributed in the drier forests, but not abundant in any one particular locality. The wood is extremely tough and elastic and is beginning to be appreciated for golf clubs. It can be obtained in logs 6 feet long by 18 inches round. It is estimated that the State forests could supply 10,000 such logs per annum at an average rate of one rupee per log delivered at a railway station.

6. *Zizyphus Jujuba*.—This is a low tree, or rather tall shrub. The wood is hard and has been used with great success as golf club-heads, for which it appears suitable. It is estimated that the State forests could supply annually 20,000 cubic feet of this wood in pieces averaging 6 feet in length and 12 to 18 inches in girth, at the price of 12 annas per cubic foot delivered on the railway.

7. *Gmelnia arborea*.—This wood works up well, and is used for various purposes by the natives of India. Among other uses to which

it is put are furniture, agricultural implements, and poles and rafters for building.

(b) RESIN.

8. *Shorea robusta*.—This resin (rál) is obtainable in moderate quantities from the sâl forests in the Central Provinces. It is estimated that 80,000 to 100,000 lbs. could be obtained annually from the forests at a cost of about sixpence a pound. The resin is used by the natives of India chiefly as incense burnt in temples and at religious sacrificial offerings.

*SOUTHERN CIRCLE.\**

- |                                     |                                    |
|-------------------------------------|------------------------------------|
| 1. Satinwood (cross section)        | } Obtained from <i>Chloroxylon</i> |
| 2. Satinwood (longitudinal section) |                                    |

This tree is abundant in the forests of the Chanda Division, and is also obtained in moderate quantities in the dry forests of Nagpur, Seoni, and Raipur. The species has suffered from excessive cutting in the past, and it is only now that a supply of mature timber is becoming available. In the future the annual outturn from the Chanda forests alone will be many thousands of tons. The specimens have been obtained from freshly-cut trees. Present selling price about sixpence per cubic foot. Cost of delivery at Coconada, on the East Coast, from the Chanda forest would probably be about sixpence per cubic foot.

**BURMA.**

1. *Bambusa gigantea*.—This bamboo, of which specimens are exhibited by the Conservator of Forests, Pegu Circle†, is synonymous with *Dendrocalamus Brandisii* and locally known as "wabo." It is an evergreen gigantic-tufted species, growing from 65 to 120 feet in height and 25 to 30 inches in circumference, the wood being an inch thick or thicker. It occurs in the forests of the Pegu Yoma and of Martaban to an elevation of 3,500 feet.

This bamboo is seldom brought out for the open market. It is cut as occasion arises either for meeting local requirements of contractors and others, or for domestic use. It is obtainable to a limited extent from the forests near Paunggyi, about 50 miles north of Rangoon, while some 10,000 to 12,000 would be available annually from the Shwemyin and Toungoo forests. On being felled, the bamboos have to be dragged or carried to a floating stream and thence rafted down the river to a distance of 200 to 300 miles, which takes from two to eight weeks before they reach Rangoon. The cost of the former operation would be from

\* Address of Conservator of Forests—Nagpur.

† Address—Rangoon.

R12 to R15 per hundred, and of the latter from R80 to R90 per thousand, according to the distance of the locality in which the bamboos are cut from the floating stream or rafted to the port of shipment.

The two specimens exhibited are 64 feet long, each cut in 4 feet sections to accompany this note, were obtained from a garden in the vicinity of Rangoon, where they are sold at R2-4 each. Bought in quantity, the price varies from R150 to R180 per hundred, exclusive of the cost of carriage, which is R1-8 to R2-8 according to distance ; but as the land on which these bamboos are found growing in the neighbourhood of Rangoon is almost entirely that of private individuals, the prices given may be taken to represent the market value only approximately. The wabo is chiefly used for purposes of rafting, floating, scaffolding, and for posts or poles for pavilions and temporary structures, carts, and other vehicles, while the hollow joints are utilised for a variety of domestic and other utensils, such as pails for water and other liquids, cases, vases, boxes, etc.

2. *Carved doorway of teak-wood prepared under the direction of and exhibited by the Conservator of Forests, Eastern Circle,\* Upper Burma.* The general outline and design of the doorway is the same as those used in the thrones and in different parts of the Mandalay palace, but the detail is more elaborate than anything which the palace contains. The triangular space above the door contains designs intended to represent the city of Mandalay with the king and his courtiers. The lowest tier shows the city wall with one of the seven-roofed gateways. On and around this are the guardian "nats" of the city and other mythological figures. The second tier is supposed to represent the king's ministers, and the highest represents the king and his queens in the palace. The whole was executed by a Mandalay carver, Maung Shwe Daing.

## ASSAM.†

### (a) TIMBERS.

1. *Michelia Champaca*.—A tall evergreen tree, wood soft, seasons and polishes well. Weight of timber per cubic foot=36 to 40 lbs. The wood is fairly plentiful; very durable and used for furniture, house-building, carriage-work and native drums; also for boats.

2. *Mesua ferrea*.—A large evergreen tree. The wood, which is plentiful, is very hard and durable, and is used for buildings, bridges, gun-stocks and tool-handles, but its more general use is prevented by its great hardness, weight, and the difficulty of working it.

3. *Schima Wallichii*.—A large and scarce evergreen tree. This wood is rough, red, moderately hard, shrinks much in seasoning, but

\* Address—Mandalay.

† Address of Conservator of Forests—Shillong.

is durable, and is chiefly used for building bridges : boats are also made of it.

4. *Shorea robusta*.—The wood is used for piles, beams, planking and railing of bridges, for beams, etc., posts for house-building, for gun-carriages, for the body of carts, and, above all, for sleepers. It is also largely used for making canoes called dug-outs. The timber is plentiful.

5. *Bombax malabaricum*.—A white wood when fresh cut, turning dark on exposure, very soft and perishable. The wood is not durable except under water, when it lasts tolerably well ; it is used for planking, packing-cases, and tea-boxes, toys, scale-boards, fishing-floats, coffins, and the lining of wells. It yields a brown gum used by natives medicinally.

6. *Bursera serrata*.—A large evergreen tree, of which the wood is used for planking and furniture.

7. *Cedrela Toona*.—This wood is durable and is universally used for furniture of all kinds, for door-panels and carvings, for boat-building, and for making tea-boxes.

8. *Amoora spectabilis*.—An evergreen tree, of which the wood is durable and takes a good polish, and is used for boat-building and furniture.

9. *Dalbergia Sissoo*.—This wood is very durable, seasons well, and does not warp or split. It is highly esteemed for all purposes where strength and elasticity are required. It is unsurpassed by any other Indian wood for felloes and naves of wheels, and carved work of every description, and for framings of carriages. It is used for boat-building, carts and carriages, agricultural implements, in construction, and especially for furniture.

10. *Acacia Catechu*.—A moderate-sized gregarious, thorny, deciduous tree, of which the wood seasons well, takes a fine polish, and is extremely durable. It is used for oil and sugarcane crushers, agricultural implements, bows, spears, sword-handles, and wheelwrights' work. It is also used in buildings for posts. The tree yields a product called catechu which is largely exported to Europe for dyeing and tanning.

11. *Albizzia procera*.—A large, deciduous, fast-growing tree. The wood is straight and even-grained, seasons well, and the heart-wood is durable. It is used for sugarcane-crushers, rice-pounders, wheels, agricultural implements, bridges and house-posts. It is occasionally used for tea-boxes and charcoal-making. It splits well and yields a copious gum.

12. *Terminalia Myriocarpa*.—A very large evergreen tree. The wood is used for building and tea-boxes, also for making charcoal.

13. *Terminalia Chebula*.—A large deciduous tree. The wood takes a good polish and is fairly durable; it is used for furniture, carts, agricultural implements and house-building. The bark is used for tanning.

14. *Lagerstræmia parviflora*.—A large deciduous tree, of which the wood is tough, elastic, seasons well, works freely, and is fairly durable. It is used for ploughs and other agricultural implements, for construction, for carriage-shafts and axe-handles. It gives a very good charcoal. Wounds in the bark exude a sweet gum. The bark is used for tanning.

15. *Lagerstræmia Reginæ*.—The wood is used for boats and canoes, for all kinds of construction, timber and carts.

16. *Cinnamomum glanduliferum*.—The wood is durable and easily worked; it is used for boat-building and planking.

17. *Stereospermum chelonoides*.—This wood is moderately durable, elastic, easy to work, and is used for building purposes and furniture-making. It is also used for boat-building.

18. *Gmelina arborea*.—The wood is easily worked, readily takes paint or varnish, and is very durable under water. It is used for planking, furniture, door-panels, carriages, well-work, boats, packing-cases and ornamental work.

19. *Morus lœvigata*.—A large tree. The wood is hard, even-grained, seasons well, with yellow or brown heart-wood.

20. *Artocarpus Chaplasha*.—A lofty deciduous tree, of which the wood is used for making boats, planking, tea-boxes and furniture.

#### (b) OILS AND RESINS.

21. Bottles of crude oil, and bottles of resin extracted from *Pinus Khasya*, a tree which is fairly plentiful. The cost of the oil exported to Calcutta is Rs per gallon.

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#### ANDAMANS.

The value of padauk (*Pterocarpus indicus*) timber, for purposes of ornamental construction and furniture, is illustrated by exhibits manufactured from this wood, and forwarded to the Exhibition, on behalf of the Government of India, by Ogilvy, Gillanders & Co., London.

## APPENDIX A.

List of Forest Maps prepared for the Chicago Exhibition of 1893  
by W. H. Reynolds, Esq., F.R.G.S., Superintendent of Forest  
Surveys. [Address—Dehra Dún, North-Western Provinces ]

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### i.—*Hanging maps*—

1. Forest Map of India.
2. Bengal Province.
3. North-Western Provinces and Oudh.
4. Punjab.
5. Central Provinces.
6. Assam.
7. Upper Burma.
8. Baluchistan.
9. Lower Burma (Pegu).
10. Berar.

### ii.—*Surveys executed by the Forest Survey Branch*—

- Nos. 11 to 21A. The 4" Singbhum maps.  
,, 22 to 29B. The 4" Kumaun and Garhwal maps.  
,, 30 to 35A. The 4" Berar maps.  
,, 36 to 45. The 2" Berar sheets.  
,, 46 to 48. The 4" Black soil villages of Melghat.  
,, 49 to 61. The 4" Dehra Dún maps.  
,, 62 to 64. The 4" maps of Gerumatergaon.  
No. 65. Kalesar Forest, 4" scale.  
,, 66 to 68. Bhagirathi Valley, 4" scale.  
,, 69 to 69A. Sheet 333  $\frac{S.E.}{2}$ , Punjab and part of Tiri-Garhwal.  
,, 70 to 76C. The 4" Bashahr maps.  
No. 77A. 4" Jubbulpore sheet.

### iii.—*Index maps*—

- Nos. 78 to 88. Different Index maps of the Forest Survey operations.

### iv.—*Records of Forest Growth*—

- Nos. 89 to 99. Bashahr 4" map.  
,, 100 to 108. Kumaun and Garhwal 4" maps.  
No. 109. Deoban Sketch map showing coniferous tracts.

### v.—*Working-Plan maps*—

- Nos. 110 to 115. Kheri maps, 2" scale.  
,, 116 to 118. Deoban working-plan, 4" scale.  
No. 119. Dambu working-plan.  
,, 120. Darugiri.  
Nos. 121 and 122. Tiri-Garhwal, 4" scale.  
No. 123. Mundáli.

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- No. 124. Korwa Forest, 4", showing compartments.  
 ,, 125. Dehra Dún working-plan.  
 ,, 126. Lachiwala coppice, 4" = 1 mile.  
 ,, 127. North-Western Provinces and Oudh, Central Circle,  
       showing forest blocks.  
 ,, 128. Changa-Mauga plantation.

*vi.—Range maps—*

- Nos. 129 to 131. Dungagalli, 2" = 1 mile.  
 No. 132. Ditto 1" = 1 mile.  
 ,, 133. Khanpur Range, 1" = 1 mile.

*vii.—Taluk maps—*

- No. 134. Elliehpur Taluk.  
 ,, 135. Dariapur Taluk.

*viii.—District and Divisional maps—*

- Nos. 136 to 139. Jaunsar District in 4 sheets, 2" scale.  
 No. 140. District Damoh, 1" = 4 miles.  
 ,, 141. District Chanda, 1" = 4 miles.  
 ,, 142. Chhindwara, 1" = 4 miles.  
 ,, 143. Saugor, 1" = 4 miles.  
 ,, 144. Kamrup, 1" = 4 miles.  
 ,, 145. Nowgong, 1" = 4 miles.  
 ,, 146. Cachar, 1" = 4 miles.  
 ,, 147. Goalpara, 1" = 4 miles.  
 ,, 147A. Nimar, 1" = 4 miles.

*ix.—Triangulation and Traverse charts—*

- Nos. 148 to 155. Perar charts, 1" = 1 mile.  
 ., 156 to 163. Kumaun and Garhwal charts, 1" = 1 mile.

*x.—Portfolio maps—*

- No. 164. Jaunsár, showing block areas, etc., entered by hand.  
 ,, 165. Dadi and Raiengarh, showing records of changes.  
 Nos. 166 to 170D. Atlas sheets of India, showing the forests, entered by  
       hand.

*xi.—Miscellaneous—*

- Nos. 171 to 175. Upper Burma, 1" maps.  
 ., 176 to 183. Chamba Survey made under local Forest Officer's supervi-  
       sion.  
 ., 184 and 185. Chamba territory,  $\frac{1}{2}$ " = 1 mile.  
 No. 186. Caoutchouc plantation (Charduar, Assam).  
 ., 187 and 188. Maps of Kangra District (compilation of).  
 No. 189. Geological map of Mussoorie.  
 ., 190. List of the best available maps in book form, with index.  
 ., 191. Traverse Indicator.  
 ., 192 to 206. Blue prints and maps in two colours.

Notes on the system of work adopted in the Forest Survey Branch.

### I.—HANGING MAPS.

No. 1.—India, showing the distribution of forest areas gazetted under the Indian Forest Laws up to 1st April 1892, and the limits of forest charges.

This map, which is on the scale of 48 miles to the inch, was compiled under the supervision of Mr. W. H. Reynolds, Superintendent of Forest Surveys. It illustrates, in colours, the reserved and protected forests under the Government of India, as well as similar forest tracts in the Madras and Bombay Presidencies. It also indicates the limits of each of the Conservator's and Divisional Officer's charges, with their headquarters stations.

This is a most useful reference and index map for forest purposes. A revised edition is published every five years, the year up to which the corrections and additions are included coinciding with that in which the quinquennial *r  sum  * of forest administration by the Inspector-General of Forests is issued. The present edition has been published a year in advance, so that it might appear at the Exhibition.

No. 2.—Map of Bengal, Behar, Orissa, and Chota-Nagpur, showing the distribution of forest areas on 1st April 1892 : scale 1" = 16 miles.

The forests in the Darjeeling, Tista, Kurseong, Jalpaiguri, and Buxa forest divisions lie chiefly on the declivities at the foot of the Himalayas. The chief tree is s  l (*Shorea robusta*). In Palamau the forest chiefly consists of s  l and khair. In Singbhum the prevailing growth is s  l ; and the vast tract of forest and swamp which occupies the southernmost portion of the Gangetic delta is the Sundarbans. The extreme length of the latter along the coast is about 165 miles, and it consists of impenetrable jungle and thick underwood traversed by gloomy-looking water-courses, the commonest tree being sundri (*Heritiera littoralis*).

No. 3.—Map of the North-Western Provinces and Oudh, showing the distribution of forest areas on 1st April 1892, scale 1" = 16 miles.

The principal forests which lie along the Nepal boundary are in reality only strips cut off from the great Nepal forests, and, like the other forests in the North-Western Provinces occupying the foot of the Himalayas, consist of s  l, *Terminalias* and *Conocarpus*, and are interspersed with open glades of grass-lands partially cultivated by jungle tribes.

No. 4.—Map of the Punjab, showing the distribution of forest areas on 1st April 1892, scale 1"=16 miles.

The principal forests in the Punjab consist of deodar (*Cedrus Libani*, var. *deodara*) along the Sutlej, Bias, Ravi, Chenab and Jhelum rivers and their tributaries. In Kangra and Gurdaspur the chir (*Pinus longifolia*) is the prevalent growth. The forests of Hazara are chiefly

*Pinus excelsa* and deodar. The forests of Rawalpindi and of the central and southern Punjab contain various species of trees of considerable size, which only in exceptional cases are fit for timber. In the higher and remote Himalayas, the silver and spruce fir, the pencil cedar, the edible pine, the oak, etc., abound and cover vast areas below the snows. The waste lands of the province, lying mostly in the plains, produce fuel and are shown in red on the map.

No. 5.—Map of the Central Provinces, showing the distribution of forest areas on 1st April 1892. The reserved areas include forests of (1) sâl, (2) bija-sâl (*Pterocarpus Marsupium*) with teak and bamboo, (3) teak, bamboo and mixed forests, and (4) anjan (*Hardwickia binata*) with teak and bamboo.

No. 6.—Map of Assam, showing the distribution of forest areas on 1st April 1892, scale 1"=8 miles.

The Brahmaputra Valley consists of rich alluvial plains comprising the deposits of ages as washed from the Himalayas on the north; and in the Khasia and Jantia Hills are mainly of granitic formations, with stratified rocks. Rich ferruginous loam is the most common soil. The forest tracts may be classed as follows:—(1) sâl forests, mostly pure; (2) shisham and khair forests, associated with *Acacia*, *Albizzia*, *Sterculia*, *Bombar*, *Lagerstroemia*, etc.; (3) mixed plain forests, consisting more or less of deciduous trees; (4) mixed lower hill forests, consisting generally of evergreen trees, with the rubber tree (*Ficus elastica*) and luxuriant bamboo vegetation; (5) pine forests, composed of more or less pure pine (on the higher lands of the Khasia Hills above 3,000 feet), of which *Pinus Khasya* predominates; (6) mixed upper hill forests, which comprise all the temperate arborescent vegetation of the higher hills, and consist chiefly of oaks, chestnuts, *Magnolia*, *Schima*, *Prunus*, *Engelhardtia*, etc.

No. 7.—Map of Upper Burma, showing the distribution of forest areas on 1st April 1892, scale 1"=8 miles.

Since the annexation of Upper Burma in January 1885, forest administration has made very rapid progress. From these forests not only are the Indian markets supplied with teak, but also Europe and the Colonies. The principal trees are teak (*Tectona grandis*), padouk (*Pterocarpus indica*), thitka (*Pentace burmanica*), ehangan (*Hopea odorata*), euteh (*Acacia catechu*), etc.

No. 8.—Map of Baluchistan, showing the distribution of forest areas on 1st April 1892, scale 1"=24 miles.

Owing to the scarcity of forest produce in the vicinity of the military and other stations in Baluchistan, and in view of the construction of frontier railways, it became necessary to establish forest conservancy,

and since 1880 a Forest Officer has been attached to this division. The forests consist chiefly of juniper, pistachio, tamarisk, etc.

No. 9.—Map of Lower Burma, Pegu Circle, showing the distribution of forest areas on 1st April 1892, scale 1"=4 miles.

The reserved forests on that date were 3,805 square miles in extent. The most important timber obtainable is the teak.

No. 10.—Berar, showing the distribution of forest areas on 1st April 1892, scale 1"=8 miles. Taking a bird's-eye view of Berar, its surface, even in the treeless plains of the Paenghat, presents groups of cultivated fields interspersed with, or surrounded and connected by, tracts and fringes of forest. A large number of these tracts are too small to be shown on this small-scale map. A reference to this is necessary,—*vide* Nos. 134 and 135, drawn on the scale of 1"=1 mile.

## II.—SURVEYS EXECUTED BY THE IMPERIAL FOREST SURVEYS.

Nos. 11 to 21A.—Government Forests in the Chota Nagpur division of Bengal, part of the Singbhum district, scale 4"=1 mile. These maps illustrate only an ordinary topographical survey of the forest boundary lines, and a strip of country about 10 chains wide, and intended as a boundary record to be bound up with the "Register of Reserves." A form showing how boundary data are recorded in the office of the Superintendent of Forest Surveys is exhibited, and is marked B. Exhibit 21A is reduced by photography and is intended as a supplement to the existing 1" scale map. The forests are composed chiefly of sâl (*Shorea robusta*). They are situated in the western part of the Singbhum district.

Nos. 22 to 29.—Government forests in the districts of Kumaun and Garhwal, North-Western Provinces and Oudh; scale 4"=1 mile, composed of eighty-three sheets, of which eight are exhibited.

Most of the reserved forests of these districts are almost free of rights, but the protected forests are heavily burdened with rights and privileges of various sorts. Within the limits of the forests are numerous patches of village lands, which have been separately demarcated. The forests are composed chiefly of sâl (*Shorea robusta*) and ehir (*Pinus longifolia*), as well as miscellaneous trees, oak, bamboo, etc.

Nos. 30 to 35A.—Government Forests in the Melghat taluk, district Ellichpur. Seven sheets are exhibited on the scale of 4" = 1 mile.

The survey was done on two scales, *viz.* 4" = 1 mile and 2"=1 mile. The 4" maps were specially intended to show the boundaries of villages and of every individual holding of land in each village. A record of rights for sheet No. 19<sup>N.W.</sup> is exhibited.

Nos. 36 to 45.—Government forests in the Melghat taluk, district Ellichpur, eleven sheets, scale 2"=1 mile. These comprise tracts in which there were but few or no villages with rights to be recorded. Those in which there were village lands were separately surveyed on the 4" scale (see Nos 46, 47, 48). The cost of the survey on the 2" scale was Rs. 57 per square mile. The tree-growth comprises a large admixture, the chief species being teak (*Tectona grandis*).

Nos. 46 to 48—Special maps of the “black-soil” villages situated within the Bairagarh reserve in the Melghat taluk, district Ellichpur, scale 4"=1 mile. The demarcation of these permanent black-soil villages has led to a considerable improvement in the condition of the migrating inhabitants of the Bairagarh reserve. It has induced them to settle permanently and has thereby benefited the forests.

Nos. 49 to 61.—Maps of Dehra Dun and the Siwaliks, scale 4"=1 mile. Parts containing forest were surveyed and drawn by the Forest Survey Department, and at the same time parts containing chiefly private lands were surveyed and drawn by the Imperial Survey Department. The survey was projected in 43 sheets (scale 4"=1 mile), of which thirteen are exhibited. These forests consist principally of sâl (*Shorea robusta*), with shisham and khair on lower ground and along the banks of rivers. There is also a considerable extent of bamboo (*Dendrocalamus strictus*) forest, and of mixed forests of trees, amongst which *Terminalia tomentosa* and *Anogeissus latifolia* are the chief.

Nos. 62 to 64.—Map of the Geru-Matergaon reserved forest in the district of Buldana, in three sheets, scale 4"=1 mile. This forest occupies an area of 73 square miles and is composed mainly of anjan (*Hardwickia binata*).

No. 65.—Map of the Kalesar reserved forests, part of sheet No. 336, scale 4"=1 mile. This survey was particularly taken up for training purposes in surveying for the students of the Imperial Forest School, Dehra Dun, in the North-Western Provinces. The forest is chiefly composed of sâl (*Shorea robusta*).

Nos. 66 to 68.—Map of the deodar forests in the Bhagirathi valley, in three sheets, scale 4"=1 mile. This forest is composed principally of deodar and contains about 18 square miles.

No. 69.—Map of the leased forests in Tiri-Garhwal, scale 4"=1 mile. This is one of the latest maps drawn by the Forest Survey Department, and is intended to illustrate the plan which regulates the working of the deodar tracts leased to the British Government by the Raja of Tiri from 1885 to 1905. These forests, which are situated at high altitudes and are difficult to get at in many places, are only accessible for survey purposes for short periods just before and immediately after the rains. They are chiefly composed of deodar.

Nos. 70 to 76.—Government forests in the Bashahr State, Punjab. Seven sheets are exhibited, scale 4"=1 mile. These maps were primarily intended to illustrate the working-plans of the forests leased by the Punjab Government from the Rajah of Bashahr, but subsequently a survey of the entire Pashahr State was ordered for topographical purposes. The Bashahr State is situated in the Himalayas, and the summits average in altitude from 4,000 to 21,000 feet above sea-level.

No. 77.—Map of the Government Forests in the Jubbulpore forest division, scale 4"=1 mile, sheet No. 107  $\frac{\text{S.E.}}{3}$ .

### III.—INDEX MAPS.

No. 78.—Index of Kumaun and Garhwal forest surveys (scale 1"=8 miles), showing the area topographically surveyed up to date.

No. 79.—Index to the forest surveys in the Melghat taluk, district Ellichpur, Berar (scale 1"=4 miles), showing the new numbering of the sheets and parts surveyed on the 4" and 2" scale respectively.

No. 80.—Index to the forest surveys in the Bhandara district, Central Provinces (scale 1"=8 miles), showing the forests with their "mabal" numbers.

No. 81.—Index to the forest surveys in the Goalpara district, Assam (scale 1"=4 miles), showing the reserved and unclassed forests.

No. 82.—Index to the forest surveys in the Raipur district, Central Provinces (scale 1"=8 miles), illustrating in colours the progress of the topographical surveys executed by the forest surveys.

No. 83.—Index to the forest surveys in the Jubbulpore district, Central Provinces (scale 1"=8 miles), showing the reserved forests and their new numbering.

No. 84.—Index to the Dehra Dun and Siwaliks surveys (scale 1"=4 miles), showing parts surveyed by the trigonometrical and forest surveys.

No. 85.—Index to the forest surveys in the East and West Salween and Attaran forest divisions, Lower Burma, Tenasserim Circle (scale 1"=8 miles), showing classes of forests.

No. 86.—Index to the Jaunsar-Bawar survey, scale 1"=3 miles.

No. 87.—Index to the forest surveys in the Singbhum district, Chota Nagpur division, Bengal (scale 1"=4 miles), showing the forest blocks and list of interior village lands.

No. 88.—Index to the forest surveys in Bashahr (scale 1"=4 miles), showing the progress of topographical surveys executed up to date, and the scales on which they have been surveyed.

All these index maps, with the exception of those for Dehra Dún and Jaunsar, were projected and drawn in connection with surveys undertaken by the Forest Survey.

#### IV.—FOREST-GROWTH RECORD MAPS.

Nos. 89 to 99.—Government forests in the Bashahr forest division, Punjab, scale  $4''=1$  mile. Eleven sheets exhibited. The record of the forest growth is made by the surveyors in the field whilst surveying. A separate tracing is prepared for this purpose, and the record is afterwards transferred to the fair sheets as the latter are published.

Nos. 100 to 108.—Maps of the districts of Kumaun and Garhwal, N. W. Provinces (scale  $4''=1$  mile), showing the record of forest growth; 83 sheets in all, of which 9 are now exhibited.

No. 109.—Sketch map of the Deoban working-circle, showing the coniferous and oak forest tracts, scale  $3''=1$  mile.

#### V.—WORKING-PLAN MAPS.

Nos. 110 to 115.—Kheri forest division, North-Western Provinces and Oudh.

Nos. 116 to 118.—Map of the Deoban working-circle and adjacent forests in Jaunsar, District Dehra Dun, in three sheets (scale  $4''=1$  mile), illustrating in colours various information.

No. 119.—Map of the Dambu reserve, Garo Hills forest division, Assam, scale  $4''=1$  mile. Drawn from tracings supplied by the Conservator of Forests, Assam.

No. 120.—Map of the Darugiri reserve in the same division, scale  $4''=1$  mile.

Nos. 121 to 122.—Government forests in Tiri-Garhwal and Jaunsar, showing the blocks and compartments of various forests, in two sheets, scale  $4'' = 1$  mile. These forests are leased from the Rajah of Tiri-Garhwal. The working-plan blocks contain an area of 24 square miles.

No. 123.—Deodar forests, Jaunsar division, North-Western Provinces and Oudh (scale  $4''=1$  mile), showing the blocks and compartments, and the areas closed and open to grazing.

No. 124.—Map of the Korwa forests in Jaunsar, showing compartment boundaries and numbers.

No. 125.—Map of the Dehra Dun reserved forests to accompany the forest working-plan, showing in colours the ranges and blocks boundaries, with an area statement.

No. 126.—Map of the Lachiwala coppice working circle, scale  $4''=1$  mile.

No. 127.—A portion of the North-Western Provinces (scale  $4''=1$  mile), showing the reserved and protected forests in the Kumaun, Garhwal, and Naini Tal forest divisions, and also the working-plan blocks.

No. 128.—Map of the Changā-Manga-plantation, Punjab, to accompany the working-plan for this area. The plantation originated in a desire to furnish a large supply of fuel to the railways in the Punjab. The forest is worked under the method of coppice with standards on a rotation of 15 years, 15 standard trees being reserved per acre. The total area under forest is 9,748 acres, which is irrigated by canal water. The growth is shisham (*Dalbergia Sissoo*). A platinotype picture of one of the compartments, taken immediately after a felling, appears in the India Court.

#### VI.—RANGE MAPS.

Nos. 129 to 132.—Maps of the Doonga-galli forest range, Hazara district, Punjab, scale 2"=1 mile and 1"=1 mile. The range contains 63 square miles of forest, the predominating species being *Pinus excelsa* nearly pure, and there are in addition mixed forests of silver-fir, oak and maple.

No. 133.—Map of the Khanpur range, Hazara district, Punjab, scale 1"=1 mile. The Khanpur forest, of 50 square miles, lies chiefly on low hills of clays and sandstones, covered for the most part with scrub jungle useful for fuel, and consisting chiefly of phulahi (*Acacia modesta*), garinda (*Carissa diffusa*), and sanatha (*Dodonaea viscosa*).

#### VII.—TALUK MAPS.

No. 134.—Map of the Ellichpur taluk, Berar, for the use of forest and revenue officers (scale 1"=1 mile), showing the classification of the district woods ("rhamnas"), grazing-lands, etc.

No. 135.—Map of the Dariapur taluk, Berar, same scale as above.

#### VIII.—DISTRICT AND DIVISIONAL MAPS.

Nos. 136 to 139.—Map of Jaunsar Bawar in 4 sheets (scale 2"=1 mile), showing the different classes of forests, etc.

No. 140.—Map of the Damoh district, Central Provinces (scale 1"=4 miles, Revenue Survey), showing the distribution of forest areas on 1st April 1892, entered by hand in the Forest Survey Office and reduced from large-scale maps.

No. 141.—Map of the Chanda district, Central Provinces, 1864-72 (scale 1"=4 miles, Revenue Survey), showing the distribution of forest areas as in No. 140.

No. 142.—Map of the Chhindwara district, Central Provinces, 1866-72 (scale 1"=4 miles, Revenue Survey), showing the distribution of forest areas as in No. 140.

No. 143.—Map of the Saugor district, Central Provinces, 1854-64 (scale 1"=4 miles, Revenue Survey), showing the distribution of forest areas as in No. 140.

No. 144.—Map of the Kamrup district, Assam, 1865-69 (scale 1"=4 miles, Revenue Survey), showing the distribution of forest areas as in No. 140.

No. 145.—Map of the Nowgong district, Assam, 1868-72 (scale 1"=4 miles, Revenue Survey), showing the distribution of forest areas as in No. 140.

No. 146.—Map of the Cachar district, Assam, 1865-74 (scale 1"=4 miles, Revenue Survey), showing the distribution of forest areas as in No. 140.

No. 147.—Map of the Goalpara district, Assam, 1855-75 (scale 1"=4 miles, Revenue Survey), showing the distribution of forest areas as in No. 140.

#### **IX.—CHARTS OF TRIANGULATION AND TRAVERSING.**

Nos. 148 to 155.—Berar sheets, scale 1"=1 mile.

Nos. 156 to 163.—Kumaun and Garhwal sheets, scale 1"=1 mile.

All surveys done by the Forest Surveys are based on trigonometrical data. To illustrate the amount of trigonometrical and traverse data, a chart of triangulation and traversing is always prepared in connection with each survey undertaken by the Department.

#### **X.—PORTFOLIO MAPS.**

No. 164.—Map of Jaunsar-Bawar, showing the Government reserved forest, block-numbers and areas; scale 1"=1 mile. The Portfolio of the Superintendent of Forest Surveys contains thousands of maps of forests on different scales. The boundaries are recorded on each map, together with notes referring to the notifications gazetting or excluding any areas affected.

No. 165.—Map of Dadi and Raiengarh, Simla Hill States (scale 2"=1 mile), showing how changes are recorded, so as to enable the officer in charge of the Portfolio to post the different several-scale maps to date.

Nos. 166 to 170D.—Atlas sheets of India, for the use of the supervising staff (scale 1"=4 miles), showing how the forests are entered.

These forests are entered on the atlas sheets by reduction with pantograph from the best printed or original large-scale available maps. The number of the atlas sheets in the Forest Survey Office to be dealt with and containing forest information amount to about 150 sheets.

## XI.—MISCELLANEOUS.

The following maps were drawn in the Forest Survey Office from tracings and sketches supplied by Forest Officers in different Provinces :—

No. 171.—Map of the Sareiktha, Nankyitha and Nanbyan forests of the Kawlin Circle, districts Ye-u and Wuntho, Upper Burma ; scale 1"=1 mile.

No. 172.—Map of the Kindat Reserve, Chindwin division ; scale 1"=1 mile.

No. 173.—Map of Bernardmyo and Ruby Mines valley ; scale 1"=1 mile.

Nos. 174 and 175.—Map of Taungdwingyi forest range, Minbu division, in 2 sheets ; scale 1"=1 mile.

Nos. 176 to 183.—Maps of the leased forests in the Chamba State, Punjab ; scale 2"=1 mile. Surveyed by native surveyor under the supervision of the local forest officers.

Nos. 184 and 185.—A general map of the Chamba territory, in two sheets, showing the boundaries of forest blocks and ranges ; scale 1"=2 miles.

No. 186.—The Charduar caoutchouc plantation, in the Darrang district, Assam, Block No. 1 ; scale 8"=1 mile.

Nos. 187 and 188.—Map of the Kangra district, Punjab, in two sheets (scale 1"=2 miles), showing the reserved forests and the proposed protected forests, with a reference table to the blocks, compiled from Revenue Survey Maps.

No. 189.—Geological map of the Mussoorie municipality, with Landour and Rajpur, North-Western Provinces and Oudh, scale 1"=1 mile ; drawn in the Office of the Superintendent of Forest Surveys from a sketch.

No. 190.—List of the best available printed forest maps on 1st April 1887.

### TRAVERSE INDICATOR.

No. 191.—The traverse indicator in use was designed by Mr. W. H. Reynolds, Superintendent of Forest Surveys, in order to facilitate the working of rectangular co-ordinates of traverse stations. A considerable saving in time and labour has been effected in the computation of traverses by its means. With the aid of this convenient diagram, the traverses can be taken out by simple inspection, and hence traverse tables are entirely dispensed with. The indicator is also used in connection with the tangent scale clinometer, for determining the position in the field of contour lines at fixed vertical intervals.

## SKELETON MAPS AND BLUE PRINTS, ETC.

Nos. 192 to 206.—Three copies each of two sheets; skeleton black print, hill-shading brown print and blue print.

## NOTES ON THE SYSTEM OF WORK ADOPTED IN THE FOREST SURVEY BRANCH.

The work hitherto accomplished by the Forest Survey differs from that ordinarily undertaken by the Imperial Survey Department, principally in that the ground is mountainous and forest-clad, such as would usually be surveyed on the scale of  $1''=1$  mile, based as a rule on triangulation only, the detail being sketched on the plane-table; and the scale and system of work adopted by the Forest Survey are more analogous to those employed in the Revenue Branch, which, generally speaking, is engaged in the survey of less rugged and more open country. The most densely-wooded tracts have been selected as forest reserves, and they are usually far from villages, and supplies and carriage are difficult to obtain. The survey is made on the comparatively large scale of  $4''=1$  mile; and, to enable the maps to be fully utilized for the purpose of valuation surveys and for the computation of the areas of compartments, as well as to enable the densely-wooded ground to be readily recognized from the maps, it is necessary to show many details, such as small ravines and spurs, and to lay them down on the maps with accuracy. The first step is to extend the triangulation previously executed by the Imperial Survey Department, so as to furnish the requisite number of fixed points for work on the larger scale. A network of traverses is then run over the ground, all important roads, paths and stream-beds being measured. The traverses are connected with the trigonometrical stations, and the numerical values of the traverse stations are calculated from them. In the case of plateaux or other level ground, traverses are run across the drainage, so as to give a sufficient number of fixed points for the guidance of the plane-tables. The plane-table work is based on the trigonometrical and traverse stations. In hilly ground the positions of all important ridges and spurs are fixed by means of plane-table intersections at short intervals, and the beds of all important water-courses are chained, the chaining being connected with the trigonometrical or traverse stations, or with points fixed by intersection on the plane-table. This work is done by native sub-surveyors, on pay varying from R8 to R31 per mensem, three or four of whom work under the direction of an European surveyor. They then sketch in the ground between the measured elevations and depressions, and it is the business of the European surveyor to check the accuracy and sufficiency of their measurements, and to complete the sketching in a correct and artistic manner. In order that it may be

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possible to distinguish at a glance on the field-sheets the portions of ground which have been accurately surveyed from those which have merely been sketched, the features which have been laid down by chain measurement, or by numerous intersections on the plane-table, are shown on the field-sheets in a different colour from the rest of the work. It is of importance to have numerous local names correctly entered on the maps. On each field-sheet is pasted a printed form in which the names within the area surveyed are entered by the plane-tabler, both in English and in the local native language, reference being made by means of letters to the localities or features of the ground to which they relate. In order to furnish a large number of altitudes, which are of so much importance for forest work, numerous observations are made with the aneroid barometer, and a printed form for the entry of the barometrical observations is pasted on to each field-sheet. Each plane-tabler is also furnished with a sheet of tracing cloth, on which he records the nature of the forest growth in such detail as is ordered from time to time. This work occupies a very short time, and, when it is intelligently done, furnishes a useful record.

The use of the theodolite for traversing has been entirely abandoned, as it has been found that satisfactory results can be obtained with a much simpler instrument, consisting of a plane-table, sight rule and compass. A circular card protractor of 12 inches diameter is pinned down on a plane-table; on it is placed a 6-inch magnetic needle, and, to enable objects largely elevated or depressed to be observed, a fine thread is stretched between the central points of the tops of the vanes of the sight rule. The first step is to mark the position of the compass-box upon the card protractor in such a manner as to eliminate the angle of variation of the magnetic needle and the angle of convergency between the meridian of the origin of the survey and that of the place where the instrument is being used. This is effected by setting up the table at a trigonometrical station near the main camp, and laying the sight rule across it at the angle of inclination of one of the sides of a triangle, at the apex of which the table stands. The top of the table is then moved round until the sight vane points down the line to the inclination of which the ruler has been laid, and when the compass needle reads zero, the position of the compass-box is marked on the card. It is manifest that the meridian-line of the card protractor will then lie parallel to the meridian of the origin of the survey, and that if the table be set up during the course of a traverse, with the compass-box laid against the mark on the card, the same position of the meridian of the card will be maintained, and the readings will all give the inclinations to the meridian of origin which are required for the computations, no angular correction, such as must be applied if a prismatic

eompass were employed, being needed. Should the work extend to a very long distance from the origin, so that the angle of convergency is much increased, it would be necessary to mark a new position for the compass-box from time to time, and in any case it is as well to correct the position of the eompass now and then, and by observation from a neighbouring trigonometrical station. The instrument is set up over each traverse station, and care is taken that the reading at each end of the diameter along which the ruler lies is the same; for it is then certain that the edge of the ruler passes over the centre of the card protractor. Back and forward readings are taken between each pair of traverse stations, and thus there is a good check on the record of angular measurements. The instrument is of course more eumbrous than an ordinary prismatic compass, but it has the following advantages over both that instrument and the theodolite. It is much less expensive than the theodolite; it is very strong, and, unless some of the parts are actually broken, it cannot get ont of order; while it is at least as quickly set up and used, and the use of it can be very quickly learnt by any native of ordinary intelligence who can read and record figures. The long needle and large arc, together with the convenience of being able to read at once the angles that are required for the computation, give it a great advantage over the prismatic compass, and the results obtained clearly show this. The arc is graduated to quarter degrees, and if the edge of the ruler lies between two marks, its position between them is estimated, and the mean of the back and forward readings is used in the eomputations. Daily, hourly, or local variations of the magnetic needle are of course to be encountered; but these are common to all instruments in which the magnetic needle is depended on. The distances are measured with chains of different lengths (Gunter's and 100-feet chains), and the measurements in feet are converted on the spot into links by means of a table, so that any error can be detected and the distance remeasured at once, if necessary. The mean of the two measurements is adopted as the true distance when working out the computations. To obviate errors due to the slope of the ground, a clinometer is used, and the distances are corrected by means of a table before being entered in the computation sheets. The traverses often run over very rough ground, such as the dry stony beds of mountain streams, and the slope is sometimes as much as  $30^{\circ}$ .

A further use is made of the traverse indicator. Each traverser is furnished with a sheet showing the correct positions (on the scale of  $4''=1$  mile) of all the trigonometrical stations in the neighbourhood of his work; and, after inspection of existing small-scale maps, the lines that he has to traverse are roughly indicated for him on it, and he plots his work on this sheet by drawing the lines each time that he sets up the table. This system has three great advantages:—1st, the plot

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made on the ground is a check against gross error, such as the reversal or the inclination of a line; 2nd, the traverser can at once see how his work progresses with reference to trigonometrical stations, and can without difficulty connect it with any that he may approach, and make sure that he will be able to close his work on a fixed point; 3rd, it is easy to indicate to him before he goes out what is required of him. The whole of the traversing is executed on the system above described.

The fair sheets are drawn on bank-post paper and are bound at their edges with cloth. Before the sheet is made over to the draughtsman, the graticule is projected by the aid of a brass frame perforated at the proper intervals, and the trigonometrical stations are plotted. In each drawing table is inserted a pane of glass, below which is fixed a tin reflector to throw the light upwards. The table is surrounded on three sides with curtains to keep out light from above. The fair sheet is laid on the table, and the field sheets which are drawn on bank-post paper mounted on thin cloth are passed under it and adjusted over the glass by means of the squares and trigonometrical stations, and the topographical detail is traced in ink directly from the field-sheets. The drawing proceeds uninterruptedly over an ordinary tracing glass, without any intermediate tracing in pencil, or the use of black transfer paper, and without considering the position of the names, which are subsequently added.

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## APPENDIX B.

Map illustrating the system of protecting forests from fire in the North-Western Provinces; on the scale of 4 inches equal to 1 mile.

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THE Rehar and Garibulchand forests, shown on this map, form part of the submontane forest belt which lies along the foot of the Himalayas from Assam in the east to the Punjab in the west. Situated as these forests are in latitude 29°N., with a rainfall of 90 inches, the climate is for seven months of the year moist, while for the other five months (February to June) more or less intense heat prevails, often accompanied by high winds.

The forests are chiefly stocked with sâl (*Shorea robusta*), a hard wood nearly evergreen, and which changes its leaves April—May.

The growth of grass, save where the trees afford complete shade, is heavy, and in damp ravines it attains a height of 12 feet; while in open glades in the forest or in grassy plains outside, it is from 2 to 4 feet high, so that during the dry season there is an enormous amount of inflammable matter always present.

These forests form two projecting arms on the southern limits of the submontane wooded belt, and are surrounded by cultivated lands on the south and south-west, and by grass-lands and scrub on the other sides.

Their exposed position, the heavy growth of grass, and the long dry season make these forests extremely difficult to protect from fire, as compared with the extensive and more sheltered tracts in the hills to the north; and for this reason, as well as for the success that has attended the measures adopted to facilitate protection, they are selected as examples.

The system may be briefly described as clearing a belt all round the outer boundary, dividing the forest into sections by interior cut lines, and during the dry season regulating the traffic through the forest. The boundary belt or outer fire-lines and the interior lines are laid out as nearly straight as possible, and they are cleared of all trees and shrubs.

The width of the outer fire-lines varies, according to the heaviness of the grass, from 15 feet to 66 feet. In the autumn of each year the grass on these lines is cut and stacked on the outer edge of the line, where it is burnt on any day when there is no wind, or when the wind is blowing away from the forest.

When feasible, any grass-land beyond the fire-line is also burnt over to a width of two or three hundred yards.

As soon as the outer fire-line is burnt, the forest is looked on as safe from all ordinary risks.

The prevailing summer wind in these forests is N.-W.; and as any fire that breaks out runs before the wind, the system of interior fire lines is dependent on this fact.

The main fire-lines are therefore laid N.-W. and S.-E., and under the most difficult circumstances these enable a fire in any section to be stopped from spreading to a section to the north or south.

Some fire-lines have been cut from north to south, but these are chiefly for purposes of traffic, as in the driest season of the year, when high winds blow, they are useless for stopping a fire, the wind having been known to carry fire before it through the air for 400 yards or more.

The interior fire-lines are all used as cart-roads or hauling-paths, and are generally 66 feet wide. The grass on these lines is cut in the autumn, and spread out on the line and burnt when the adjacent grass is still green. The roads and paths are in the middle of the lines so that there is a clear belt on each side for use in checking a fire.

In addition to the system of fire-lines, the following precautions are also observed :—

For the three driest months, April to June, the forest is closed for the collection of produce, and work is confined to carting timber or fuel previously hauled into an inner fire-line or outside the outer line ; while there is also a patrolling establishment kept up, which patrols the outer line to keep off trespassers and regulate the hauling of produce collected, as noted above. The protected area in these forests is only 32 square miles ; and as nearly 79 miles of fire-lines have to be cleared annually, the cost is very high, and has during the last five years averaged \$544 (Rs. 1,813), or \$16·32 per square mile per annum. During the same period three fires occurred, which spread over 4½ per cent. of the forest area.

Where the forest area is larger and the circumstances are less trying, the same system is followed, but with fewer and less expensive fire-lines, etc.; and while the percentage of failures is smaller, the cost is from \$2 to \$4 per square mile.





